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The Antikythera Mechanism:

The Greek Computer of Science and Reason

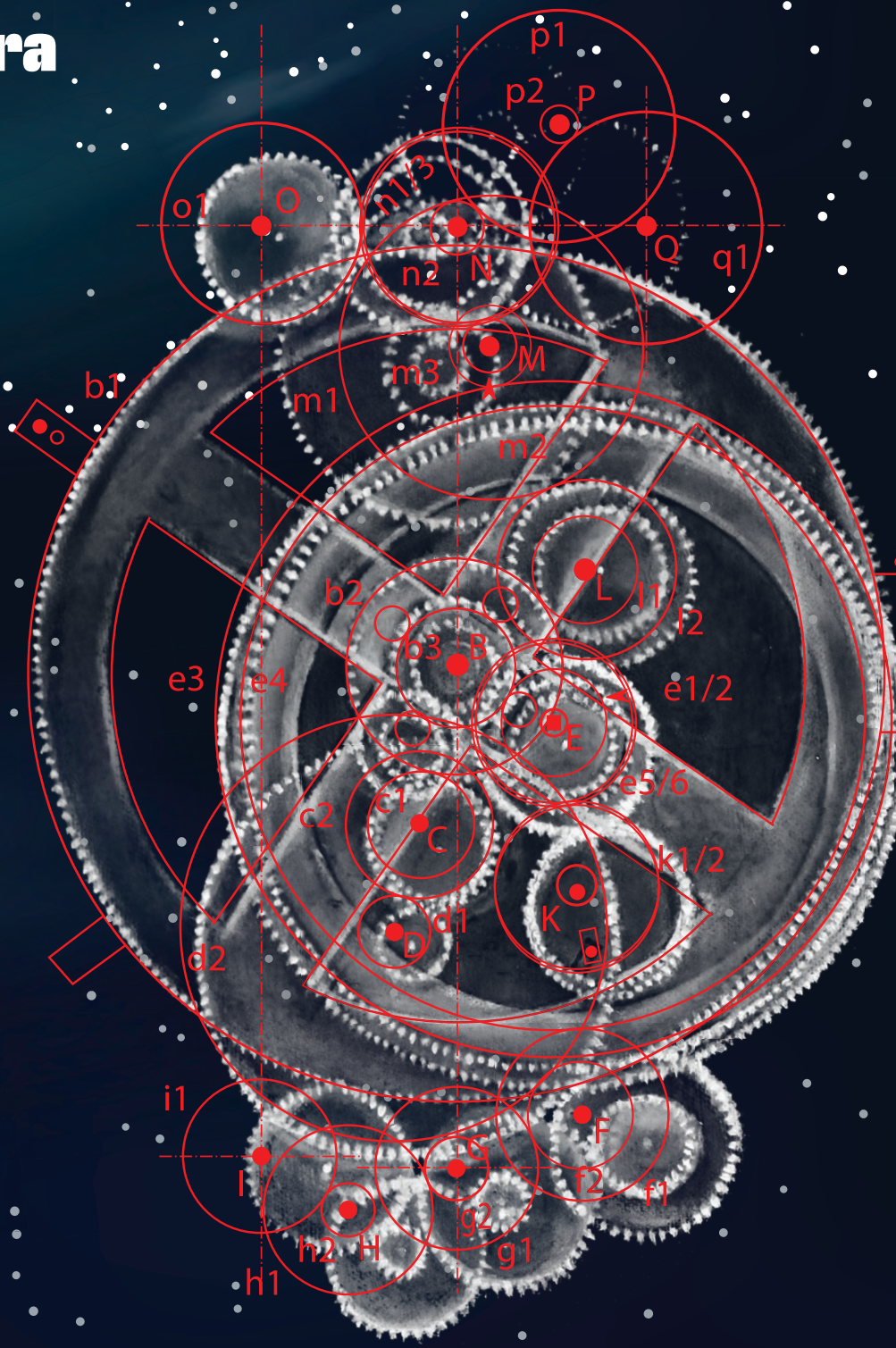
Carl Sagan's Lost Lecture on Science and Civil Liberties
Steven Pinker and **Harvey Silverglate**

Relativism and Identity Politics

Queen Mary Hauntings? The Real Story

Dinosaur Bones and Radiocar-bunkum

Young-Earth Creationist Pseudoscience



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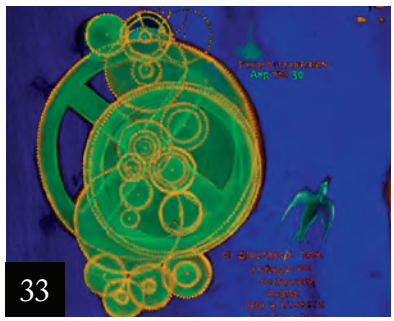

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[FROM THE EDITOR

Our Debt to the Ancient Greeks

Ten years ago, my wife, Ruth, and I had the incredible good fortune to take a remarkable trip with four friends: four days of sailing in the eastern Aegean Sea on a Turkish wooden sailing ship called a *gulet* followed by a ground tour of southwestern Turkey's Ionian peninsula. We started at Bodrum and drove north to Didyma, Miletus, Priene, and Ephesus. Our guides were fine at showing us all the massive ruins of ancient Greek amphitheaters, monuments, and cities. They were not so good at pointing out the great *ideas* that originated there: This was where the great Ionian philosophers lived—Thales of Miletus, Heraclitus, Anaximander, and many others. Offshore to the left as we drove north all one day loomed the island of Samos. Samos! That's where Pythagoras lived! That's where Aristarchus ("The Ancient Copernicus") lived and studied the heavens! I was right there! Only a few years earlier, I had heard historian Richard Berthold lecture about the "electrifying moment in world history" when the Ionian natural philosophers came up with the idea of rationality—in which logic, consistency, and natural causation reigned and myths were merely poetry. The ideas of humanism and individualism arose. Doubt and inquiry were encouraged. These ideas, that the world is knowable and not a passive pinball of supernatural forces, created a burst of intellectual inquiry.

All these thoughts and memories flooded back to me as I first read the manuscript for our cover article, "The Antikythera Mechanism: The Greek Computer of Science and Reason." Evaggelos Vallianatos, with a doctorate in Greek-European history, became fascinated with the story of a bronze tooth-geared astronomical computer found in fragments undersea in 1900 and now in an Athens museum. He investigated, eventually writing his own book about this newly appreciated scientific marvel of Greek civilization. He places the find within the context of ancient Greek science and culture, where laws and reason governed the Greek gods and instilled the notion of a universe regulated by natural laws. He believes the real scientific father of the Antikythera machine is Hipparchos, who had a laboratory in Rhodes, where the mechanism came into being. Hipparchos also invented trigonometry and theorized that the Moon moves around Earth in an elliptical orbit.

My thoughts continue. What if the intellectual openness and ferment that motivated these remarkable natural philosophers (the word *scientist* wasn't invented until 1834) had continued? And why didn't it? A mob burned the great Library of Alexandria, repository of all the world's knowledge—a terrible crime against humanity. Vallianatos attributes the demise of the Antikythera computer to the fact that Christianity nearly wiped out the Greeks and their civilization, "driving the rich world of Greek philosophy, science, and technology—such as the Antikythera Mechanism—into the shadows." The Dark Ages followed. Plagues and natural disasters also contributed, but nevertheless did one set of ideas have to fall prey to another?

And that leads to other thoughts. When religious extremism and dogma stifle open inquiry, human history can be diverted from vigorous advances that improve human welfare into more sterile pathways—for centuries. It has happened before. Can it happen again?

—Kendrick Frazier

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On Memory and Bravery: When You Can Be Screamed at and Honored on the Same Day

ELIZABETH LOFTUS

Editor's note: Psychologist and CSI Fellow Elizabeth Loftus is one of the world's leading experts on human memory. She has long been outspoken in her criticisms of the controversial claims about repressed memories and innovative in her research showing how false memories can easily be created. She is Distinguished Professor of Psychological Science, Criminology, and Law and Society at the University of California, Irvine. On July 14, 2022, she delivered the commencement address at Australian National University (ANU) and received an honorary doctorate "for exceptional contributions to psychological science, pioneering applications to the administration of justice, and her unwavering pursuit of scientific freedom." This is her talk.

Elizabeth Loftus, left, receiving her honorary doctorate from the Hon. Julie Bishop, chancellor of Australian National University (ANU) in July. Bishop is ANU's first female chancellor.

As I prepared to travel to Australia for ANU's commencement, I and millions of other citizens in my country were glued to the Congressional hearings investigating the deadly attack on our Capitol on January 6, 2021—an armed and violent insurrection designed to overthrow the legitimate election that made Joe Biden president by seven million votes. One bit of standout testimony about the insurrection came from a young woman named Cassidy Hutchinson. She was in her mid-twenties, not much older than many of you, and a half century younger than me. She had been a White House aide and assistant to Donald Trump's chief of staff. She worked only a few feet from the Oval Office and clearly was in an insider position. There was nothing special about her; she was one of the legions of foot soldiers who work for any political party, the ones who show up every day to support their party and their president. But Hutchinson's testimony was particularly damaging to former President Donald Trump, as she calmly detailed the behavior of the chief of staff, her boss, and the many others who were aiding and abetting Trump

in his lies about a stolen election, his embrace of the armed rioters, his reluctance to call off the crowds, his temper tantrum when his own Secret Service whisked him away instead of letting him go to the Capitol. When she was asked how she felt about what she was observing firsthand, she said that as a staff member in the administration, she was "frustrated and disappointed." And then she added: "As an American, I was disgusted. It was unpatriotic. It was un-American. We were watching the Capitol building get defaced over a lie."

There she was, in the spotlight, with a choice she thought she would never have to make: support her bosses and party, be silent, obey orders—or tell the truth.

Many observers were dazzled by Hutchinson's calm testimony; one politician said she was "one of the most brave and honorable people I know." But almost at once, Republicans began accusing Hutchinson of betraying her party, lying, and making up stories. Indeed, at the hearings, one Republican after another told chilling stories of the abuse and threats they endured for testifying to the truth—threats on their lives and their children's, being called the vilest of names, being hounded on the internet and in person day and night.

Watching Cassidy Hutchinson's testimony made me want to talk to you about bravery. Some people seem brave by nature; they set out to change the world or pursue justice in the face of relentless opposition, or they run into burning buildings and freezing rivers to rescue a victim. But that's not the way bravery usually works. What happens for most people, at some unexpected time in their lives, is that they are tested. They face an issue, like whether or not to report wrongdoing that they observe at work, or they are called upon to testify, like Cassidy Hutchinson, and they have to decide: Am I going to tell the truth? Or am I going to play it safe, keep my head down, go along with the crowd? Hey, I have a family and job to protect, don't I? I want my friends to like me, right? No wonder bravery is difficult.

When I started out in my profession studying human memory, I never expected that I, or my work, would prove to be as explosively divisive as it has become—that, like Cassidy, I too would be screamed at for being shameful and dishonest *and* honored for being impressively courageous, sometimes on the same day. How should I think about these two diametrically opposite descriptions of me? And why did the study of memory prove to be so inflammatory?

You almost certainly have encountered memory disputes in your own life, as when you and your sibling disagree about some past event, or you and a friend argue about who started an argument. People don't *like* having their memories questioned—it can feel very unsettling. But I have been studying disputed memories for many years and learned that it's one thing when people disagree about a childhood memory but it's quite another when people witness crimes and accidents and other important events and disagree about what they saw. I wanted to understand this. What happens to their memories? How accurate are they? How permanent? Working with many research partners, I did hundreds of studies showing that you could easily change people's memories for significant events: You could make people believe that a thief had a red coat rather than a gray one, or that two cars smashed into each other rather than simply bumping each other's fenders. You could even make people believe they "remembered" entire experiences that they never had, such as being attacked by a vicious bully or even being abducted by aliens.

When I started out in my profession, studying human memory, I never expected that I, or my work, would prove to be as explosively divisive as it has become.

These studies showed us that the past is not indelibly etched in stone—or wired once and for all somewhere in a corner of the brain—but a living, breathing reality that takes shape as we revisit our own stories. Our memories are not literal truths but, at least in part, creative manipulations of fact. Layered on each remembered event of our lives is the icing of dream, myth, and wishful thinking. To make it all more complicated, every time we tell a memory, we are rehearsing it, modifying it, adding details … until, over time, it may have changed a great deal from the original version.

These research findings were crucial for helping us understand how witnesses to crimes can develop mistaken memories—and how, tragically, their mistaken memories can and have led to the conviction of innocent people. Our experiments helped us see how highly suggestive interviewing practices or even suggestive psychotherapy can lead people to develop bizarre false memories that can destroy their own lives and those of their loved ones.

And then, thirty years ago, as I was getting deep into research on the distortions of memory, the Recovered Memory Movement first erupted. I never imagined that recovered memory hysteria would envelop the United Kingdom, Australia, the United States, and other parts of the world—thousands of people going into therapy and coming out believing bizarre memories of abuse and torture, uncorroborated and in many cases flatly contradicted by evidence. Alleged memories that divided and destroyed countless families. Allegations against parents and daycare teachers that were hysterical and preposterous but put hundreds upon hundreds of people in prison or otherwise destroyed their lives. When I started to speak out about these injustices, and offer the evidence from psychological science, I was unprepared for the hostility that came my way—from psychotherapists who were promoting the unsubstantiated notion of repressed memories of trauma and from their patients who were victims of their treatments. I received barrages of threatening letters. A woman on a

plane, recognizing me, swatted me with her magazine. Coordinated efforts tried to get me fired from my job. Threats of violence were aimed at organizations that had invited me to speak. Amongst the worst was having to defend a lawsuit brought by a daughter who had accused her mother of sexual abuse based on memories that were, in my view, highly suspicious. I never imagined that mistaken views about memory could ruin so many lives. I found myself drawn into the position of defending the science—and defending people falsely or mistakenly accused—and for my efforts, big trouble came my way.

I'm not Don Quixote, that great character in the seventeenth-century Spanish novel who soaked himself in romances and dreams of adventure and then set out to be a chivalrous knight, rescuing damsels in distress and protecting the innocent. I didn't set out to be brave, to fight the forces of pseudoscience and dogma with the sword of science. And yet I had to keep speaking up.

Coming back to you, ANU graduates. In the safety and specialness of this day, you might not be thinking about bravery or courage, but for many of you there will come a day when you will be faced with a choice you will have to make: integrity vs. convenience, doing the right thing or justifying the wrong thing. Will you take the brave path and step up, or will you play it safe? Will you blow the whistle on some unethical practice in your company, risking your job, or will you remain silent? Some choices must be made instantly, and sometimes you'll have a bit longer to think about what you want to do. What choice will you make?

I do know that once faced with the choice between yielding to the wave of hostility and criticism that my research provoked or standing as strong as I could for science and justice, the answer was a no-brainer for me. As I look back, I feel pride about the work that I've done as a psychological scientist. I'm proud of the fact that I was able to help so many people along the way, particularly when my work has helped prevent innocent people from being found guilty in a court of law. It's pretty powerful when you know that you have helped to save even one life.

My point is this: It has not been easy to pay the price for doing work that threatens some people's cherished beliefs, questions their certainty about their memories and experiences, or throws doubt on the story they have created to explain their life. But there are rewards aplenty—not only the immense emotional satisfaction you feel when you've saved a life, but also the immense intellectual satisfaction you feel when you've contributed to our understanding of a phenomenon as central to human life as memory—work that has helped countless couples and families realize that their different memories are perfectly normal and there's no need to go to war over them.

Most of all, there is a deep gratification in knowing that my profession and the academic enterprise that I love and work for appreciates my labors. Which is why, at this moment, this honorary doctorate from ANU means so very much to me. Thank you. ■

Acknowledgment

Thanks to Carol Tavris, a brave skeptic herself, for many discussions of bravery and her myriad contributions to my thoughts on the topic.

[COMMENTARY]

A Brief History of *Bunk*

JOE NICKELL

The familiar word *bunk* (short for its original form *buncombe*) has a clear origin and colorful history important to skeptics.

The word *bunk* traces back to 1820 when the U.S. House of Representatives was debating what would come to be known as the Missouri Compromise, regarding the question of slavery in new territories. After nearly a month of fierce argument, members called for an immediate vote on the matter.

Instead, congressman Felix Walker—who represented Buncombe County, North Carolina (named for Revolutionary War Colonel Edward Buncombe)—rose to speak. He provoked and exasperated colleagues by launching into a lengthy, wearisome oration—not, as he announced, directly to Congress but rather to his constituents back home, "to Buncombe." He was reportedly shouted down by his angry audience, but the address was later published in a Washington newspaper.

The incident transformed the word *buncombe* into a synonym for political empty talk, and later—respelled "bunkum"—into a word for "nonsense" of whatever variety.

Wiktionary, like most standard dictionaries, regards the word *bunkum* and its short form *bunk* as "U.S. slang" or "English slang." As such, a problem with *bunk* is that it is hardly suitable for use where seriousness is called for—such as in scientific or legal writing. Another problem is that it is imprecise: Do you mean to simply say that the referent is "nonsense" or that it is "pseudoscience"? Or—what *do* you mean to say?

Furthermore, the use of slang may say more about the person making the declaration than about what is being disparaged. For example, it may result in

To call oneself a debunker can imply bias suggesting—rightly or wrongly—that the results are known prior to investigation.

the user being regarded as a hothead. (I think some believe it makes them sound tough, but as one who has put tough guys in jail, I am not impressed by it.)

Derivatives of *bunk* are also problematical. Wiktionary defines *debunk* as "to discredit or expose the falsehood of something." It gives as an example: "The explosion story was thoroughly *debunked* on National Public Radio in November 1999." Is that a factual statement or a biased assertion? Wouldn't it at least be more convincing if instead of "debunked" it read, "examined and thoroughly disproved"?

Worse, however, the statement that something "was debunked" uses what in grammar is termed *passive voice*, which indicates that the verb is receiving the action. Because there is no *subject* to perform the action (as with active voice), the statement is unclear as to just who or what did the alleged debunking.

Consider which of the following is more effective: "All this talk about Bigfoot is just a bunch of bunk"; or "Science has never found a specimen of Bigfoot, and many sightings could be explained as upright-standing bears." The first is a crude, slang expression, too sweeping to convince anyone but another dismisser. However, the second one is evidence-based and offers a plausible explanation for many sightings.

Now, some skeptics refer to themselves as "debunkers," which is unfortunate. Although thorough investigation may often result in the discrediting of fanciful claims, to call oneself a *debunker* can imply bias suggesting—rightly or wrongly—that the results are known prior to investigation for certain topics.

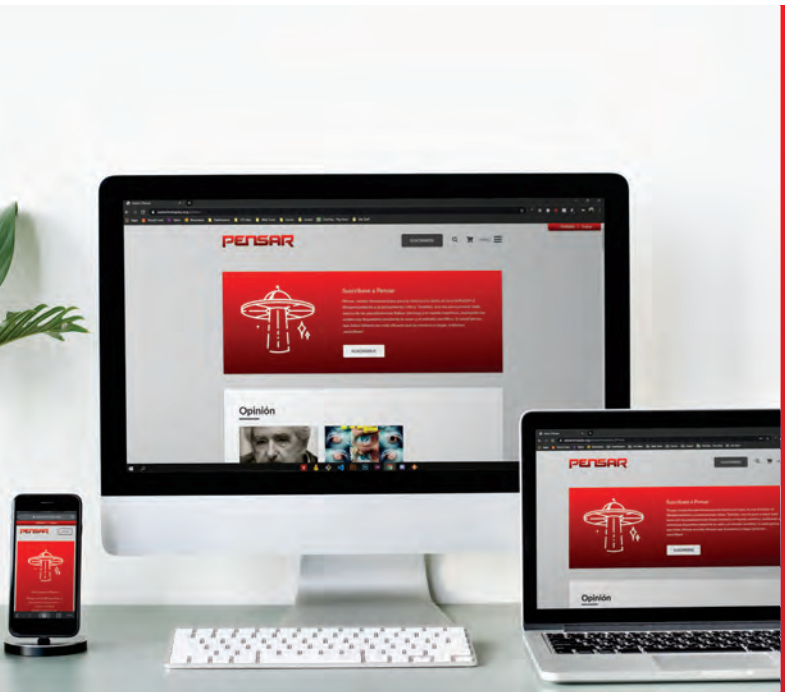
During my half-century career, I have often been introduced on radio shows as a "well-known debunker" or the like. I found that many talk show hosts thought they were paying me a compliment, but to many listeners the label signaled something more akin to "closed-minded dismisser." By avoiding the term, I believe I have improved my credibility and engaged in more successful conversations. As early as 1988 in my book *Secrets of the Supernatural,* I began to advocate such an approach for skeptics.

The following year (in the Spring 1989 Skeptical Inquirer) brought an article by physicist Al Seckel. Its title presented the well-received theme: "Rather Than Just Debunking, Encourage People to Think." He emphasized:

> The skeptical movement *can* be an extremely valuable social force if it puts the emphasis on teaching better reasoning skills rather than confining itself simply to debunking erroneous popular notions. Unfortunately the opportunity to use the pseudosciences to teach reasoning skills is too often missed.

Significantly, the great skeptic James Randi (1928–2020) also took up this important cause. As he explained a few years before his death, "I am a debunker, yes, by definition, but I think *scientific investigator* covers it better." Randi preferred to be positive rather than negative whenever possible—one of his many qualities we would do well to emulate. ■

Joe Nickell, a former magician and Pinkerton detective, taught technical writing for engineering students for several years while obtaining his PhD in English. He has written nearly fifty books, many critically examining extraordinary claims.



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What Happened to the COVID-19 Power of Prayer Study?

EDZARD ERNST

Dr. Dhanunjaya Lakkireddy is a cardiologist of some repute, the director of the Kansas City Heart Rhythm Institute with many sound publications under his belt. It was therefore with considerable surprise that the medical community learned of his plans to conduct a study of prayer for preventing deaths in COVID-19 patients.

The trial created headlines in 2020 when it was first announced. *The Christian Post*, for instance, wrote this:

> An international team of doctors, led by Kansas City cardiologist Dr. Dhanunjaya Lakkireddy of the Kansas City Heart Rhythm Institute, is currently conducting a clinical study to measure the impact of prayer in the health outcomes of coronavirus patients.
>
> "Prayer is often used as a medium to invoke divine intervention for affirmation of life, healing of the sick and protection of the vulnerable. This often remains a controversial intervention from a scientific perspective. Although used regularly in the inpatient setting of critically ill patients, the benefit of prayer on healthcare outcomes has been heavily debated," the researchers noted in the overview of the study. …
>
> Lakkireddy explained in an interview with NPR that the study will involve 1,000 patients with coronavirus infections severe enough that they require intensive care. All the patients will receive the standard of care prescribed by their medical providers but half of the randomly chosen patients will receive a "universal" prayer from one of five religions. …
>
> Lakkireddy said the medical professionals he has assembled for the study's steering committee are also all people of faith. "We all believe in science and we also believe in faith," he told NPR … Lakkireddy, who was "born into Hinduism," noted that he attended a Catholic school and spent time in synagogues, Buddhist monasteries and mosques. "I believe in the power of all religions," he said. "I think if we believe in the wonders of God and the universal good of any

> religion, then we've got to combine hands and join the forces of each of these faiths together for the single cause of saving humanity from this pandemic." (Blair 2020)

As originally planned, the study was to involve 1,000 patients with COVID-19 infections severe enough to require intensive care (Gjelton 2020). To be precise, the four-month study was to investigate the role of remote intercessory multi-denominational prayer on clinical outcomes in COVID-19 patients. Following are some of its features as published before the trial started.

Inclusion Criteria

Male or female greater than eighteen years of age; confirmed positive for COVID-19; patient admitted to Intensive Care Unit.

Exclusion Criteria

Patients admitted to ICU for diagnosis that is not COVID-19 positive (interestingly, not giving informed consent was not listed as an exclusion criterion).

Interventions

Half the patients were to receive a "universal" prayer offered in five denominational forms, via Buddhism, Christianity, Hinduism, Islam, and Judaism. The 500 patients in the control group would not be prayed for by the prayer group. In addition, the patients from both groups were to receive the standard care as prescribed by their medical providers.

Outcome Measures

Time patients remain on ventilators, number of patients who suffer from organ failure, time patients remain in intensive care, and mortality rate.

Lakkireddy said: "If there is a supernatural power, which a lot of us believe, would that power of prayer and divine intervention change the outcomes in a concerted fashion? That was our question." As mentioned, the start of the study was announced in 2020. A trial of this nature takes a while to complete, evaluate, write up, and publish. I thus waited patiently until the results would emerge. But sadly, they didn't. Why not? I was puzzled and became more and more frustrated. Until I had the rather obvious idea of looking at the NIH website that reported the above details two years ago. There was the explanation: "Recruitment Status: Terminated (Due to the low enrollment, this study is closed. Analysis of data is not performed.)" (U.S. National Library of Medicine 2022).

But how can this be? What can possibly be the reason for an enrollment that was too low to properly conclude this trial? There were certainly enough COVID-19 patients (contrary to what was claimed earlier, the sample size is now given at merely 200). Many of these U.S. patients would, of course, be religious and thus welcome some divine intervention.

So, why might such a trial fail? I was unable to find a plausible explanation. Whatever the reason, I find the whole proposed study disappointing—possibly even unethical—and I see numerous problems:

- Research funds are notoriously scarce and should not be wasted on testing implausible hypotheses.
- There is no guarantee that the control group would not also receive prayers by friends and relatives.
- It could be argued that personalized prayers might be more powerful than those from the prayer group of unrelated people.
- It is questionable whether it is acceptable for individuals of one religion to receive prayers from another faith.
- It is questionable whether it is acceptable to quietly change the protocol of a trial without ethics approval.
- The sponsor of this study was the Kansas City Heart Rhythm Institute. Its director is Dhanunjaya Lakkireddy, the principal investigator. This introduces conflicts of various types.
- When the study was first announced in 2020, it received considerable publicity, and we thus have a right to learn why the study was aborted.

So, the COVID-19 Prayer Study turned out to be poor science, poor ethics, and poor execution. Nonetheless, I see it as a proof of the power of prayer: since the trial was announced, I (and probably many other skeptics as well) have been praying for it to fail! ■

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Edzard Ernst is emeritus professor, University of Exeter, and a noted researcher into claims of alternative medicine. His recent books include *Charles, the Alternative Prince: An Unauthorized Biography* and *So-Called Alternative Medicine (SCAM) for Cancer.*

[POSTCARDS FROM REALITY

ROBYN E. BLUMNER

Robyn E. Blumner is president and CEO of the Center for Inquiry and executive director of the Richard Dawkins Foundation for Reason & Science. She is a lawyer who previously held posts as a syndicated columnist and editorial writer at the *Tampa Bay Times* and as executive director of the ACLU of Florida and ACLU of Utah.

Junk Medicine in Dentistry

StellaLife markets a set of products that it says relieves pain and swelling after gum and dental surgery. At its website, StellaLife offers gushing testimonials and fawning videos of dentists endorsing its products, including its flagship offering, the VEGA Oral Care Recovery Kit.

Typical of the praise is this, from consulting periodontist Dr. Lee Sheldon in Florida:

> I am so pleased that StellaLife is a routine tool in our practice. With so much success in speeding healing and reducing postoperative pain, we keep testing the limits of this product. "Let's try StellaLife" has become a routine refrain in our practice for any type of acute or chronic mouth soreness and our patients are rewarded with a solution that they, nor we, ever had in our practice. I have seldom seen a safe breakthrough product of this magnitude.

Dr. Farhad Boltchi, a periodontist in Texas, goes even further:

> The StellaLife VEGA Oral Care products are indispensable adjunctive wound care products in our practice. They significantly improve wound healing and patient discomfort following standard and complex surgical procedures. In addition, they are our primary initial remedy for the treatment of various mucocutaneous disease conditions.

StellaLife also claims that its Oral Care Recovery Kit "accelerates healing" from: "extractions (including wisdom teeth), dental implants (including all-on-4, all-on-6), bone and connective tissue grafting, LANAP, osseous surgery, crown lengthening, sinus lift, ridge augmentation, and other procedures including SRP."

I don't know what half those procedures are, but the ones I do know are no fun to go through. A product that relieves pain and discomfort and speeds healing would certainly make dental surgery less scary.

But there's a catch. There is no scientific evidence that the products work.

You see, StellaLife products are homeopathic. If they conform to homeopathic protocols, as the labeling suggests, there is nothing in them that would provide the relief promised unless you count the placebo effect as effective therapy. And, as to remedying disease conditions? Not happening.

The "science" behind all homeopathic products is a bunch of hogwash formulated in the late 1700s by a man who posited a medical hypothesis that dilution of an active ingredient to the point of elimination makes it more potent. Turns out, that's completely wrong. Frankly, that's no surprise.

In fact, the underlying premises of homeopathy are so far-fetched that the Federal Trade Commission (FTC) warned in 2016 that homeopathic drugs will be considered deceptively advertised if the consumer is not alerted to the fact that "1) there is no scientific evidence that the product works; and 2) the product's claims are based only on theories of homeopathy from the 1700s that are not accepted by most modern medical experts."

The FTC also says that these disclosures need to stand out and that marketers should not reduce the impact of these statements with claims of the product's efficacy or endorsements.

StellaLife bends these rules on its packaging and its website.

How did I learn about StellaLife? Following periodontal surgery, I received the StellaLife VEGA Oral Care Recovery Kit from my doctor. This kit included an "antimicrobial" rinse to promote "oral health" and a spray and gel for "pain and swelling relief."

StellaLife claims that thousands of dental and medical practices and pharmacies stock its wares. In addition, the product can be purchased for $89.97 directly from the StellaLife website.

When I got home and examined the package more closely, I saw that it said "homeopathic" on the front in lettering much smaller than its claim of "Intelligent Healing," which is one of its registered trademarks.

Everywhere on the box where the products claim they are effective medicine, there is an asterisk. When you finally find where all those asterisks are defined, it says "Claims based on traditional homeopathic practice, not accepted medical evidence. Not FDA evaluated." Nowhere does it explain what homeopathy is or how it ostensibly "works."

I contacted my periodontist, and after I educated him on homeopathic medicine, he quickly ended ties with StellaLife.

Since then, CFI's Legal Department contacted the dentists whose stories appeared on the company's website, warning that they were endorsing unproven products based on quack medical theories and that recommending StellaLife products to their patients could violate their ethical duties.

That got the company's attention. In April, we received a "cease and desist" letter from a major law firm representing StellaLife. The law firm claims we are defaming the company and interfering with its contractual relations with the endorsing dentists.

Our response, in a word: Nuts!

We told the law firm that we had said nothing false and that our mission includes educating the public about pseudoscience such as homeopathy.

Our efforts also got the attention of the intrepid Quackwatcher Dr. Stephen Barrett. His investigation, which he wrote about on our Quackwatch website (Barrett 2022), included a deep dive into StellaLife's "Research" page, where the company claims it does "high-quality research" on everything it sells.

The research page lists forty articles. Barrett found that not one of the publications included a study with the proper controls, where patients and doctors were "blinded" and didn't know who received the intervention and who received a placebo. Most were case reports about one or more patients. They were purely anecdotal and not any kind of controlled study.

When both Barrett and CFI's Legal Department contacted the American Dental Association (ADA) to raise concerns about the company and its claims, we got the brush-off.

CFI Legal Director Nick Little wrote the ADA last year, suggesting that the ADA remind its members that homeopathic products are fake medicine and recommending them may violate their professional duty to their patients. The ADA's president, Cesar Sabates, DDS, wrote to us in November that our concerns had been "forwarded to the ADA agency vested with the responsibility for ethics and professionalism, the Council on Ethics, Bylaws and Judicial Affairs." He also said he "requested that the Council assess the need for any such reminders, subject to any applicable legal and regulatory constraints that may apply."

Since then, crickets.

The response Barrett received in July from Sabates said that while the ADA is "not unsympathetic" to the concerns about the StellaLife oral recovery products, the group is "not equipped" to do the "significant research and testing" that would be required to determine whether those concerns are valid.

Really? StellaLife readily admits that the claims for its homeopathic products are not based on scientific evidence. No extensive lab work is needed to figure that out.

StellaLife is selling hype and misleading patients, and the ADA should say so. ■

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Barrett, Stephen. 2022. Be wary of StellaLife homeopathic dental products. Online at https://quackwatch.org/dental/questionable/be-wary-of-stellalife-homeopathic-dental-products/.

Joe Nickell, PhD, is a former stage magician and Pinkerton detective who has spent more than half a century solving the world's strange mysteries using the techniques of science.

Solving the Hidden-Tomb Mystery at Rosslyn Chapel

Certain curious "vaults" of the "strange mysteries" variety are at far-flung sites around the world. They typically fall into two categories: *burial vaults* with some unusual activity, or *treasure hoards* that tend to be lost or perpetually inaccessible—or both. Over the years, beginning about 1979, I began to uncover the underlying secrets of these sites—which were invariably linked to a secret order's allegories, rituals, and arcana.

Now, in the wake of fantasies spread by the book *The Da Vinci Code* and the movie of the same title, I have chanced upon another vault tale: the purportedly hidden burial chamber of Scotland's Rosslyn Chapel, which brings new imagery to the "secret vault" genre. Can we discover—or explain—where the hidden Rosslyn chamber actually lies and solve the accompanying mystery?

Mysteries at Rosslyn

Our interest is drawn to a small chapel in the scenic Scottish countryside of Midlothian, near Edinburgh. Constructed during 1446–ca. 1486, when Scotland was Catholic (i.e., before the Protestant Reformation), the chapel resembles a miniature Gothic cathedral. It was the private chapel of Sir William Sinclair (1410–1484), who resided with his family at nearby Sinclair Castle. During the subsequent three centuries, it slowly fell into disrepair, until poet William Wordsworth (1770–1850) huddled there during a thunderstorm. He wrote a poem—"Composed in Roslin [*sic*] Chapel During a Storm"—and he and his sister impressed Queen Victoria with the need for its restoration.

The chapel was launched into world prominence by *The Da Vinci Code* (Brown 2004), which in turn relied heavily on another book, *Holy Blood, Holy Grail* (Baigentet al. 1996). According to these fanciful, pseudohistorical works, Jesus was married to Mary Magdalene, with whom he had a child. Thus began a holy "royal bloodline," leading to a succession of kings who ruled what

is today France from 481 to 751 CE. Alleged proof of this "secret" included a trove of parchment documents—actually old forgeries. Also touted was Leonardo da Vinci's fresco *Last Supper* (which I visited in Milan with Italian investigative writer Massimo Polidoro). Supposedly, the painting contains hidden symbolism relating to the "royal blood" theory (Nickell 2013, 142–143). Because of an imagined connection with the medieval order Knights Templar, Rosslyn Chapel earned a location scene in the film *The Da Vinci Code* (Butler and Ritchie 2013, 1–11, 230–231).

On our way to investigating the hidden burial-chamber claim, let us first take a look at one other mystery at Rosslyn. This will help set the stage for the discussion of that mystery. I am referring to the skull and other alleged relics of St. Matthew, one of Jesus's disciples and the purported author of the first gospel. These relics are supposedly hidden in the "vault." However, history is not supportive of the notion that any of Matthew's relics even survived. Saints' relics were in such great demand that they were routinely faked, prompting Protestant reformer John Calvin (1509–1564) to publish his scathing *Treatise on Relics* (Calvin 1543).

Now, Matthew's purported relics were once displayed in a thriving abbey in Brittany named after him (*St. Mathieu*)—among other places! Unfortunately, those relics are completely lacking in provenance (historical record) until the ninth and tenth centuries (depending on which of various legends one credits), so their identification as Matthew's is doubtful in the extreme. Worse, the relics' whereabouts are unknown after 1558—when the abbey St. Mathieu was ravaged by an English fleet, along with much else, along Brittany's coastline. Because Henry VIII had specifically ordered the destruction of saints' relics, it is most likely that Matthew's relics were destroyed at that time.

Nevertheless, authors Butler and Ritchie (2013, 36–40, 63) cannot help but speculate that the rumored "vault" supposedly beneath Rosslyn Chapel might hold not only the burials of some missing Sinclairs but also the long lost skull of St. Matthew—possibly in its original, presumably ornate, reliquary. Freemasons, especially, would like to know. But is the search historically honest? Or can an undug skull represent skullduggery?

'Secret Vault' Narratives

Freemasons insist theirs is not a "secret society" but rather a "society with secrets." Carried to North America in the eighteenth century, Freemasonry has been defined as "a peculiar system of morality veiled in allegory and illustrated by symbols" (*Masonic Heirloom Edition Holy Bible* 1964, 26). (An allegory is a fictional narrative presenting a moral that is unstated, being left for others to discover.) The "secret vault" stories feature Masonic symbolism—especially from the Royal Arch degree—which pertains to lost secrets, buried treasure, and the grave (Macoy 1908; Nickell 1988, 140).

The "secret vault" of Masonic allegory concerns King Solomon's subterranean depository of certain great secrets.

Specifically, the "secret vault" of Masonic allegory concerns King Solomon's subterranean depository of certain great secrets. The rites of the Master Mason degree feature a quest after such vague secrets—specifically "that which is lost." The vault is symbolic of the grave, which is regarded as an entrance into eternal life. In the Royal Arch degree, the striking of stone—to see whether it sounds hollow or solid—is the means by which the secret vault is sought and finally located (Duncan 1972, 242).

Among the burial-vault types of such Masonic tales is one from Stanton in Suffolk, England, known as early as 1815. It tells of coffins mysteriously "displaced." It may be a model for other "restless" coffins stories, including one on an island in the Baltic and still others—notably two proliferating sets of tales in Barbados that are the most famous. All these are shown to have Masonic involvement, based on my studies as well as research I commissioned in Barbados (Nickell 1988, 143–147).

The other strain of vault stories is like that of the purported Beale Papers of Virginia, which tell a tale of adventure, unsolved ciphers, and a fabulous lode of gold and silver. They were published by Virginia Freemason James Ward. Another, even more famous example, is the legend of Oak Island, Nova Scotia, which has an alleged Money Pit that became the focus of endless digging and much involvement by Freemasons. However, my onsite investigation indicated that both the pit and subterranean "pirate tunnels" are natural formations. Still another treasure tale of the genre is Swift's lost silver mine of eastern Kentucky, supposedly walled up—according to a punning phrase—"with masonry form" (Nickell 2001, 228–229).

As if these "true" accounts were not enough, there are overtly fictional ones as well: witness the Sherlock Holmes stories by Arthur Conan Doyle, himself a Freemason. For instance, Holmes uncovers dark secrets in "The Adventure of Shoscombe Old Place." Beneath a crumbling chapel on the Shoscombe property, accessed by stumbling through "loose masonry" (again, note the pun) and proceeding down a steep stair, the detective discovers a crypt with an "arched … roof" (evoking Masonry's Royal Arch degree). Accompanied by his client—for good measure named "Mr. Mason"!—Holmes finds the key to a series of strange mysteries. Similarly allusive Holmes stories are "The Red-Headed League" (featuring an underground bank vault and a client sporting a Masonic breastpin) and the suggestively titled "The Musgrave Ritual" (Nickell 2001, 228). To mention just one more, "The Adventure of the Retired Colourman" features a hermetically sealed "strong room." By turning an outside tap, one could fill the vault with gas, making it a murder chamber. A Holmes ally in the case is twice mentioned as wearing a large Masonic tiepin (Doyle n.d.).

Solving Rosslyn's Vault Secret

As the foregoing examples make clear, *secret vaults* (to use a specifically Masonic term) have long been utilized by Freemasons for their allegorical and symbolic purposes. Like other myths in the society—essential for us to understand—"the historical relation may be true or it may be false; it may be founded on fact or the invention of imagination; the lesson is still there, and the symbolism teaches it exclusive of the history" (*Revised Knight Templarism Illustrated* 1975, 64 n. 22).

Therefore, as at Oak Island and elsewhere, whoever assumes that a given secret vault is based on fact is liable to be deceived. The number of individuals who have thus been misled into searching for (nonexistent) treasure, or hoping to make some (highly implausible) historical discovery, is incalculable. I fear the Rosslyn secret chamber is also of this all-too-familiar mold. Certainly, the Sinclairs had a lengthy, close involvement with Freemasonry, and Sir William Sinclair of Rosslyn was Grand Master of early Scottish Masons in 1630 (Butler and Ritchie 2013, 12, 183).

Butler and Ritchie in *Rosslyn Chapel Decoded* frankly encode more than they decode. Among their many speculations—that there may be a hidden Sinclair vault, that it could contain missing Sinclair ancestors, that it might also contain the skull of St. Matthew, and more—there is yet very little proof of anything. Our narrators are mostly engaged in mystery mongering regarding the imagined vault. (More skullduggery?)

They cite supposed "legends" of a "tradition in which sons of the Sinclair family of Rosslyn would be buried in a vault within the Chapel—in full battle armor." They suggest the story is surely true, but that the vault's location "was eventually forgotten." In 1837, they note, when the vault was needed for a burial, a week's searching was unproductive. Holes were purportedly drilled in the masonry, and whole floor slabs were lifted up, yet—although there were old burials underneath—there was no sign of the legendary vault. The authors do concede that "we have no idea where the earls of old were buried." They report having heard of a group of U.S. naval personnel who allegedly brought in ground detection equipment in the 1970s that revealed "tunnels" below, but no details are forthcoming. No source is specified for the 1837 search.

They suggest "the crypt" as a possible site of an entranceway, possibly a structure earlier than the chapel. Unfortunately, that feature is something else entirely: not a crypt but actually the *sacristy* (or vestry), i.e., the room for vestments and sacred vessels. And there is no evidence there of any entranceway for anything subterranean, the authors admit, conceding that the legendary chamber might actually be in the family castle instead of the chapel (Butler and Ritchie 2013, 63–67). Or, of course, it might be nowhere.

I advise patience: there is no telling what future legends may someday bring. Meanwhile, Masons continue to flock to Rosslyn Chapel—in part at least inspired by the chapel's own homegrown legend. As we have seen, there are many secret vault stories worldwide with a connection to the Masons, but it has been my lot to uniquely discover and reveal their actual Masonic purpose. To those, I here add one more—be it real or otherwise: the purported secret vault beneath Rosslyn Chapel, lost to the ages, if not to the imagination. ■

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[THE PHILOSOPHER'S CORNER] MASSIMO PIGLIUCCI

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The (Linguistic) Fall of Rationality

If you ever suspected that the beginning of the end of the world happened around 1980, there is now some scientific evidence to back up your intuition. An intriguing paper authored by a group of researchers in the Netherlands comprising Marten Scheffera, Ingrid van de Leemputa, Els Weinansa, and Johan Bollen and published in the prestigious *Proceedings of the National Academy of Sciences (PNAS) USA* (Scheffera et al. 2021) gives us skeptics quite a bit to chew on and ponder. Let me first sketch out the methodology and main findings, and then we'll tackle the more prickly issue of what it all may (or may not) mean.

Scheffera and collaborators looked at the frequency of words indicating either rationality or emotion in several large databases across the period of time from 1850 to 2019. They took words such as *experiment*, *circuit*, *chemistry*, *gravity*, *weigh*, *depth*, *greater*, *per*, and several others to indicate the use of rational discourse. By contrast, they regarded words such as *imagine*, *compassion*, *forgiveness*, *heal*, etc., as related to emotional discourse.

Their main findings come from quantitatively analyzing, via Google nGram, all the books in both English and Spanish catalogued by the search engine company. But they also repeated the analysis using articles from *The New York Times* over the same period, as well as using a smaller sample of words in publications from additional languages, including French, German, Italian, and Russian. The goal was to discover whether usage of either group of words—characterizing rationality or emotion—changed over time.

It did—dramatically so—and in a way that suggests a rise in rationality-related words until about 1980, followed by the beginning of a decline that has become significantly sharper from 2007 on. Emotionally related words were characterized by the exact reverse trend. Moreover, Scheffera and colleagues noticed that such patterns are parallel to a symmetric switch between words emphasizing a collective versus an individualistic focus, as well as a shift from plural to singular pronouns, again beginning around 1980 and accelerating by 2007.

Methodologically, the paper is solid. To begin with, it was published in one of the top scientific journals in the world, which relies on rigorous peer review. Moreover, the authors have taken several precautions in analyzing their data and building internal controls—for instance, by confirming their findings on books by way of a second dataset of newspaper articles, as well as expanding the number of languages they consid-

ered. They also subdivided their book data according to whether a given entry was categorized as fiction or nonfiction, standardizing the entries by the frequency of the word *an*—which is recognized to be an indicator of total text volume. In all cases, they obtained exactly the same results, suggesting a high degree of robustness of their findings.

I am also familiar with several of the statistical tools they used, from the use of z-scores to principal components analysis, and it seems to me they did it right. Of course, linguistics is a social science, not fundamental physics, and plenty of methodological and analytical criticisms have been raised about this paper. Nevertheless, for the moment the results stand.

But what do they mean? This is where things get more speculative, as the researchers admit. Still, there is no point in doing science without reasonably speculating on the meaning of one's findings, as that sort of exercise—usually reserved for the discussion section of a paper—may in turn generate additional testable hypotheses and thus spur future research.

Naturally, Scheffera and collaborators went searching for global or at least large-scale phenomena that could explain first the steady rise of rationality-oriented language (from 1850 to the late 1970s), then the inversion of the trend (around 1980), and finally the acceleration of the reversal (2007).

They suggest that the rise in rationality-oriented language was the result of a steady increase in the prestige of science, from its status as natural philosophy, which it still had in the time of Charles Darwin, to the increasingly spectacular advancements in both basic science and technology during the twentieth century. That seems plausible enough, but things get a bit trickier when we come to the potential explanation of the 1980 pivot. As the authors put it:

> What precisely caused the observed stagnation in the long-term trend around 1980 remains perhaps even more difficult to pinpoint. The late 1980s witnessed the start of the internet and its growing role in society. Perhaps more importantly, there could be a connection to tensions arising from neoliberal policies which were defended on rational arguments, while the economic fruits were reaped by an increasingly small fraction of societies.

This is obviously going to be controversial, because if they are correct, we have a causal link between economics and politics on the one hand and a massive attitudinal shift in the general public on the other. Depending on whether you support neoliberalism or not, or on whether you think a move from rational to emotional language is problematic or welcome, you will react differently to the *PNAS* paper. And of course, it is going to be mighty difficult to test the suggested causal link. It's one thing to demonstrate a robust data pattern, repeatable across a series of datasets. It's an altogether different thing to tease apart the underlying causal factors.

What about the acceleration in the trend seen since 2007? The researchers' first thought was of a potential link with the financial crisis that hit the world at about that time. The results of the crisis, for most people, were similar to the overall outcome of the neoliberal shift described above: enriching the few and pushing the many further down, economically speaking. But if that were the case, then one would have expected a comparable, or even larger, effect of the even more dramatic Great Depression, which lasted from 1929 to 1939. But no such effect is visible in the data.

The other major thing that happened around 2007 was the rise of social media, and it is there that the authors of the paper focus their attention, writing, in part:

> Various lines of evidence underpin the plausibility of an impact of social media on emotions, interests, and worldviews. For instance, there may be negative effects of the use of social media on subjective well-being. This can in part be related to distortions such as the perception that your friends are more successful, have more friends, and are happier and more beautiful than you are.

Add to this the phenomena of fake news and alternative facts, the perception (justified or not as it may be) of increasingly complex and insoluble global problems, as well as the increasing popularity of alternative life styles to cope with all this, and you may have the makings of a further acceleration away from rational discourse and toward emotional talk.

May have, of course, being the operative words. This research highlights what is fascinating and frustrating about social science. On the one hand, it is increasingly possible to gather enormous datasets to begin to address a variety of interesting questions or simply to explore patterns and detect new signals. On the other hand, it is fiendishly difficult to test causal hypotheses in anything like a rigorous manner.

Two additional factors complicate things. First, it is extremely easy (one might want to say too easy) to generate a plethora of causal hypotheses. I'm inclined to think that the suggestions made by Scheffera et al. to explain their data are reasonable. But all sorts of other things happened in 1980 and 2007, and five minutes of reflection may generate several alternative hypotheses to account for the trends. Second, this kind of research strikes at the heart of things we truly care about, often passionately. This is about human psychology, politics, and economics. We are all bound to have strong opinions concerning this stuff, and such opinions inevitably color our perception of what is going on—whether we are the researchers who work in the field or casual readers of a newspaper article summarizing the findings.

Regardless of specific and more or less likely explanations, though, this research has shown convincingly that there has indeed been a significant and steady drop in the use of words related to rational discourse and a concomitant rise of words related to emotional discourse. Is this problematic and unwelcome? That too depends on our perception of the world and what matters to us, and the science isn't going to tell us whether we should be worried or celebrate. ■

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[REALITY IS THE BEST MEDICINE] HARRIET HALL

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Understanding Gluten

Until a few years ago, few people had even heard of gluten. Now going on a gluten-free diet has become a popular fad. People diagnosed with celiac disease must avoid gluten to prevent symptoms, but others are avoiding gluten for questionable reasons—or for no reason at all. I watched a TV program where the host stopped random people on the street to ask them about gluten. Many of them didn't even know what gluten was, but nevertheless, they were convinced it was unhealthy and should be avoided. Although only 1 percent of Americans have celiac disease, 30 percent of Americans reported that they were trying to avoid gluten. An article on NPR called it "the dietary boogeyman du jour" (Fell 2015).

Celiac Disease

Other names for celiac disease are celiac sprue, non-tropical sprue, and gluten-sensitive enteropathy. The classic symptoms are diarrhea, abdominal pain, bloating, weight loss, malabsorption, and failure to thrive. Other gastrointestinal symptoms may include mouth sores, gastroesophageal reflux, and recurrent nausea and vomiting. There are countless extraintestinal manifestations, including rash, arthritis, amenorrhea, anemia, chronic fatigue, osteoporosis, depression, infertility, epilepsy, fractures, neuropathy, miscarriage, and more.

Screening is not recommended. No test is diagnostic; the diagnosis is established by a combination of blood tests, esophagogastroduodenoscopy with small bowel biopsy, and the patient's response to a gluten-free diet. It has been estimated that up to 83 percent of Americans with celiac disease remain undiagnosed or misdiagnosed (Beyond Celiac n.d.). Some patients have no symptoms but still have pathognomonic damage to the small intestine. Some groups are at increased risk: first-degree relatives of patients with celiac disease (10 percent risk), type 1 diabetics (2–8 percent), people with certain genetic disorders (Down syndrome 8 percent,

Turner syndrome 6 percent, etc.), and those with immunoglobulin deficiency (2–8 percent) and autoimmune thyroid disorders (6 percent) (Williams et al. 2022).

Blood tests are useless if patients have already chosen to go on a gluten-free diet; they must first go back on a gluten-containing diet for two to six weeks. The best blood test for screening those at risk is an immunoglobulin A tissue transglutaminase test (IgA *t*TG), which has a high sensitivity (95 percent) and specificity (95 percent). Total IgA levels should be measured, because 2–3 percent of celiac patients will have an IgA deficiency. Low IgA levels should be followed by IgG testing (IgG deamidated gliadin peptides and IgG *t*TG). And the IgA endomysial antibody test is useful for confirmatory testing. Human leukocyte antigen (HLA) alleles DQ2 and DQ8 are not used for diagnosis, but they represent a major genetic risk factor, and a negative test for both rules out celiac disease, with a negative predictive value of greater than 99 percent.

In celiac disease, there is atrophy and flattening of the villi in the small intestine, causing malabsorption. Biopsies demonstrate this atrophy as well as other typical pathological findings of celiac disease. Endoscopy can be done as an outpatient. Four to six biopsies are taken from the duodenum. For patients unwilling to undergo endoscopy, another option is video capsule endoscopy. One in four patients with celiac disease develop an itchy, blistering rash called dermatitis herpetiformis, most commonly on the buttocks, elbows, knees, scalp, or lower back. The rash responds quickly to treatment with dapsone, but long-term management requires a gluten-free diet.

What Is Gluten? Safe and Unsafe Alternatives

Gluten is a protein with viscoelastic and adhesive properties that makes up 75–85 percent of the protein in bread wheat. Gluten is developed as the dough is kneaded. It helps the dough rise and contributes to its chewy texture. Grains to be avoided for those sensitive to gluten are wheat, barley, malt, rye, kamut, semolina, triticale, and spelt. Safe grains that are gluten-free are amaranth, buckwheat, corn, millet, oats, quinoa, rice, sorghum, and teff.

Flour alternatives include:

- Any of the safe grains
- Legumes, such as chickpeas, kidney beans, lentils, navy beans, pea beans, peanuts, and soybeans
- Nuts, such as almonds, cashews, chestnuts, hazelnuts, and walnuts
- Seeds, such as flax, pumpkin, and sunflower
- Tubers, such as arrowroot, jicama, potato, tapioca, and taro

Effects of Popularity

A lot of people have jumped on the gluten-free bandwagon. When a friend of mine joined a gluten-free support group, he learned that he was the only one there who had been diagnosed by a doctor. The popularity of gluten-free diets has been both good and bad for patients with celiac disease. Gluten-free products are now much easier to find, and awareness has brought acceptance by restaurants and the public. But the association with fad diets has also brought many people to suspect that those claiming to have celiac disease are just faddists who are making things up.

When a friend of mine joined a gluten-free support group, he learned that he was the only one there who had been diagnosed by a doctor.

Other Diagnoses

Some people who follow a gluten-free diet do so in the belief that they are treating an illness that is not celiac disease. They have symptoms that subside when they follow a gluten-free diet, but they have not been diagnosed with celiac disease. They may think they have a wheat allergy or a non-celiac gluten sensitivity (NCGS). Estimates of the prevalence of NCGS vary; it may be as low as 0.6 percent or as high as 13 percent of the general population.

Wheat allergy is real. It involves IgG and mast cell response. Within minutes to hours of eating something with wheat in it, allergic patients typically develop swelling or itching in the mouth or throat, a skin rash or hives, nasal congestion, headache, problems breathing, cramps, nausea, vomiting, or diarrhea. They could even have an anaphylactic reaction, a medical emergency that could be fatal. There is some overlap between the symptoms of wheat allergy and celiac disease, but they are not the same thing; it should be fairly easy to distinguish them from each other on clinical grounds. An allergy specialist can diagnose wheat allergy with skin tests, blood tests, food challenges, and elimination diets. Gluten is not the only allergen in wheat: it also contains twenty-six other potential allergens (Sotkovský et al. 2011). When diagnosed in children, over half of wheat allergies resolve spontaneously as they get older.

If celiac disease and wheat allergy can be ruled out, symptoms that respond to a gluten-free diet could be due to NCGS. The diagnosis of NCGS is controversial and is still being debated. Many investigators question whether it is real. It may be confused with irritable bowel syndrome (IBS).

And then there are FODMAPS: fermentable oligosaccharides, disaccharides, monosaccharides, and polyols. That's quite a mouthful; it's easy to see why people prefer to use the acronym, which reduces the syllable count from twenty-three to two. These short-chain carbohydrates tend to absorb water and ferment in the colon; the resulting distention causes discomfort in some people. No inflammation is involved. Low FODMAP diets improve symptoms in people with functional bowel disorders, but they could disrupt the intestinal microbiome and may carry a risk of nutritional inadequacy. Low FODMAP diets restrict the carbohydrates in certain grains, while gluten-free diets restrict the protein. So far there have been

no studies comparing the gluten-free diet to the low FODMAP diet.

A gluten-free diet is difficult to follow, although the new widespread availability of foods labeled *gluten-free* has made it easier. Avoiding gluten is not only difficult for the individual but also creates problems for others around them, including family members, those who prepare their food, and those who serve them or eat with them at restaurants. They may face misunderstanding and ridicule from those who think of gluten-free diets as a food fad and assume celiac patients are just confused or are imagining things.

Some people give reasons for avoiding gluten that simply don't make sense:

- "Wheat is a common allergen." Sure, but it's far more common to *not* be allergic to wheat. Wouldn't it be better to find out whether you belong to the small minority or the vast majority before you commit to life-long dietary restrictions?
- "Gluten can be inflammatory." But that's only if you are sensitive to gluten.
- "Gluten may cause thyroid problems." That's questionable. There is some research suggesting that a gluten-free diet can help reduce antibody levels in autoimmune thyroid disease. Do you have autoimmune thyroid disease?
- "Gluten products aren't necessarily nutrient dense." So what?
- "It is estimated that up to 13 percent of the population has NCGS." Which would mean that at least 87 percent of the population does not.
- "Gluten may block nutrient absorption." But that's only if you have gluten sensitivity or celiac disease.
- "Weight loss." It doesn't work.
- "Autism." Not supported by research.

Elimination Diets

Because people are avoiding gluten for questionable reasons, more research is needed. Well-designed studies with control groups can provide credible evidence, but patients will try to do their own research by experimenting with elimination diets, and that's a mistake. If they respond well, it could be a placebo effect. They are proud of taking control, want to feel better, and may convince themselves they feel better in some way. But they may still be eating problem foods without realizing it. They can't control the way food is prepared in other people's homes and in restaurants. Meals eaten away from home may include ingredients they are trying to avoid. A restaurant that offers a gluten-free menu may inadvertently include trace amounts of forbidden foods, such as flour used to thicken gravy, or there could be cross-contamination from other foods cooked on the same grill. If people feel worse on an elimination diet, it might not be due to the target food but to the absence of other foods they are in the habit of eating.

Follow Science, Not Fads

In short, there are two groups of people currently following a gluten-free diet: those who have been properly diagnosed by a doctor with celiac disease and who really need to avoid gluten to maintain good health and those who have self-diagnosed and who may or may not benefit from avoiding gluten. There are others with undiagnosed celiac disease who should avoid gluten but don't yet know it. ■

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[BEHAVIOR & BELIEF STUART VYSE

Stuart Vyse is a psychologist and author of *Believing in Magic: The Psychology of Superstition*, which won the William James Book Award of the American Psychological Association. He is a fellow of the Committee for Skeptical Inquiry.

Eat Popcorn: The Current State of the Priming 'Train Wreck'

The story is the stuff of advertising legend. In 1957 at a movie theater in New Jersey, messages too brief to be consciously detected were flashed on the screen during a movie: "DRINK COCA-COLA" and "EAT POPCORN." Without knowing why they were doing it, people streamed to the concession stand and plunked down good money for overpriced movie snacks. The marketing researcher James M. Vicary reported a 37 percent increase in popcorn sales and an 18 percent increase in Coca-Cola sales (Karremans et al. 2006; Strahan et al. 2002). In the same year, Vance Packard published the bestselling *Hidden Persuaders* (1957) aimed at describing the subtle ways that marketers were influencing consumers' choices, and in 1974, Wilson Bryan Key published *Subliminal Seduction*, filled with illustrations that he claimed demonstrated how advertisers were enticing consumers with sexual messages.

Despite the potential advantages for product marketing, many people found this all a bit disturbing, and the cultural climate in the United States didn't always help matters. A year before *Hidden Persuaders* appeared, *Invasion of the Body Snatchers* was a box office hit, and in 1962, at the height of Cold War tensions, *The Manchurian Candidate* was released. Although it happens every day, people don't like the prospect of being controlled by unseen forces. This worry seems to be one of the themes of current fears about artificial intelligence, as well as a possible reason many of my friends are afraid to have a smart speaker in their homes. "I don't want Amazon listening to my private conversations all day long." In response to worries about unfair practices, the United Kingdom and several other countries—but not the United States—have passed laws prohibiting subliminal advertising (BBC 2015).

In a famous 1996 legal case, James Vance sued the British rock band Judas Priest, claiming that the band's song "Better by You, Better Than Me" contained the subliminal phrase "Do It," which caused him and a friend, Ray Belknap, to attempt suicide (Moore 1996). Belknap died, but Vance survived with serious injuries. Judas Priest said they were unaware of any subliminal messages in their songs, but they failed to get the case dismissed on free speech grounds because the judge ruled that subliminal messages were an invasion of privacy that was not protected by the First Amendment. However, the judge did grant a summary judgment for the defendants, because the plaintiffs could not prove that any subliminal messages were present in the songs.

Fortunately, many of the worst fears about subliminal messaging are unfounded. Vicary eventually admitted that his movie popcorn study was a complete hoax. It never happened. Furthermore, as we will see, in general, subliminal and other priming effects prove to be nonexistent or much more modest than previously believed (Karremans et al. 2006). For example, a study of subliminal training self-help audiotapes marketed to help people quit smoking, lose weight, or achieve higher

self-esteem revealed that any benefit was caused by a placebo effect. Just giving people a tape and telling them it had subliminal messages on it was good enough, whether there were any subliminal messages or not (Greenwald et al. 1991).

What Are We Talking About?

For reasons I will speculate on later in this article, research into subliminal effects and the larger category of priming effects has been fraught with controversy from the beginning. The problem came to a head in 2012 when Nobel Prize–winning psychologist Daniel Kahneman wrote an open letter to priming researchers in which he claimed "your field is now the poster child for doubts about the integrity of psychological research" and suggested that a "train wreck is looming" for young researchers who are associated with this topic of study (Yong 2012). But before we get to the train wreck, let's be clear about what priming effects are.

A typical priming effect is a fairly immediate response to something in the environment. However, unlike merely following directions or getting an idea to do something, the response to a priming stimulus is passive—not intended—and the person making it is unaware of its influence (Bargh 2016). The priming stimulus need not be subliminal. It can be quite obvious, but the individual is unaware of its effect. For example, in a classic but controversial experiment, John Bargh and colleagues gave college students scrambled sentences to unscramble (Bargh et al. 1996, Experiments 2a and 2b). The students were given groups of five words (e.g., "he it hides finds instantly") and were asked to rearrange the words into grammatical sentences. For some participants, the scrambled-sentence task included words that suggested an elderly stereotype (e.g., "worried, Florida, old, grey"), and for other participants the scrambled words were neutral. Later, all the participants were surreptitiously timed as they walked down a hall leaving the laboratory, and Bargh and colleagues reported that the students exposed to words suggesting an elderly stereotype walked significantly more slowly leaving the laboratory. The participants had seen and understood all the words as they unscrambled them, but subsequent interviews determined that only one participant had any idea that the elderly words might be connected with their walking speed. For all the other subjects, the effect of the priming words had been completely unconscious.

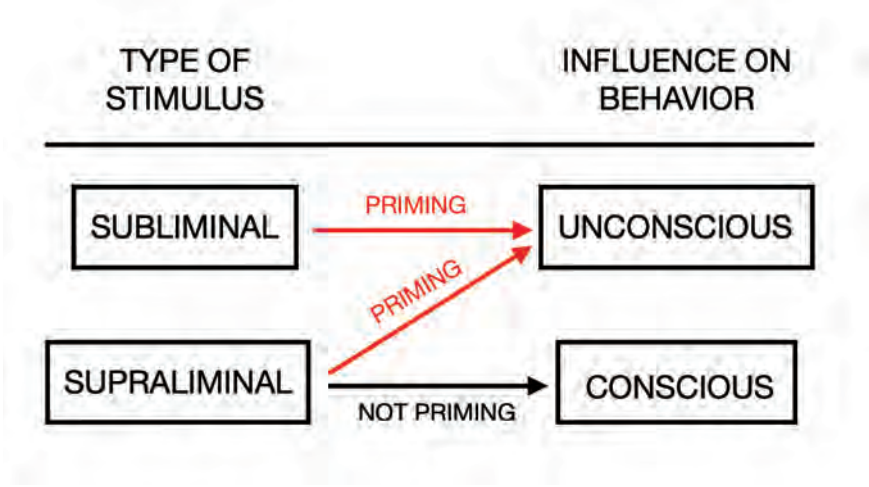


Figure 1. The relationship between the type of stimulus and the kind of effect it produces. Priming stimuli can be either subliminal (below the level of perception) or supraliminal (easily seen or heard), but their effects on behavior are unconscious. (Figure based on an article by Kolenda [n.d.].)

In another study, a liquor store featuring displays of both German and French wines played French music and German music on the store sound system on alternate days. The researchers found that wine sales fluctuated with the music being played (e.g., more French wine sold on days when French music was being played) and that, in a post-purchase questionnaire, customers were unaware of the influence of the music on their behavior (North et al. 1999).

When they occur, priming effects are presumed to be caused by unconscious associations. The knowledge and memories that we carry around in our heads are not randomly filed in there. Things that we have encountered together in the past are held together in memory: old people and Florida, hotdogs and mustard, French music and French wine. Stimulating the memory of a particular sound, object, or idea has a spreading effect on a network of related associations, and these associations unconsciously affect our behavior.

A Slow-Motion Train Wreck

In 2005, Stanford University professor John Ioannidis published a paper with the provocative title "Why Most Published Research Findings Are False" (Ioannidis 2005). He identified a bias among journals in favor of publishing successful experiments and evidence of widespread statistical manipulation to produce the desired outcome of a successful experiment. In medicine, psychology, and other related fields, there was a growing sense that many studies that had appeared in textbooks for decades might not be reliable. The controversy later became known as the "Reproducibility Crisis," and the problem in psychology was confirmed when a large-scale attempt to reproduce the results of 100 studies previously published in three prominent psychology journals found that, although 97 percent of the original studies had reported statistically significant results, only 68 percent of the replicated studies were significant (Open Science Collaboration et al. 2015). Not a great track record.

Part of the problem was publication bias. Journals in many fields have a strong bias in favor of publishing positive results—studies in which the hypotheses being tested are shown to be valid. Daniele Fanelli of the University of Edinburgh conducted a survey of 2,434 published articles in twenty different science disciplines ranging from the traditionally "hard" sciences (e.g.,

space science) to the "soft" sciences (e.g., psychology/psychiatry). As Figure 2 shows, she found that the highest levels of positive findings were in articles published in psychology/psychiatry (Fanelli 2010). Based on her sample, studies in psychology, psychiatry, economics, and business were approximately five times as likely to report significant results than space science. This kind of publication bias creates great pressure among researchers to come up with statistically significant findings, and in an earlier column I confessed to my own past as a "p-hacker," manipulating the results of psychology studies to eke out a statistically significant result, traditionally indicated by a probability, *p*, of less than 5 percent (Vyse 2017). At the time, long before the Reproducibility Crisis, we were taught that p-hacking was standard operating procedure.

It was in this atmosphere of reexamination and skepticism about research in psychology that things started to come apart for priming research. In 2012, Stéphane Doyen of the Université Libre de Bruxelles and colleagues attempted to recreate the results of Bargh's elderly stereotype priming study and were unable to reproduce the original results (Doyen et al. 2012). Doyen and colleagues used twice the number of participants as Bargh and introduced several controls. For example, Bargh and his collaborators timed the students walking down the hall with a stop watch, introducing the possibility of experimenter error. In contrast, Doyen and colleagues automatically timed their participants' speed of walking using infrared sensors at each end of the hallway. In a second experiment, Doyen and colleagues were able to duplicate the slow-walking effect but only after manipulating the experimenter's expectations about the outcome. Although in Bargh's original experiment the people who timed the walking were unaware of whether or not the participants had received the elderly stereotype primes, it was unclear what the experimenters administering the scrambled sentences knew about the expected results. As a result, there was a possibility of unconscious experimenter bias affecting the behavior of the student participants.

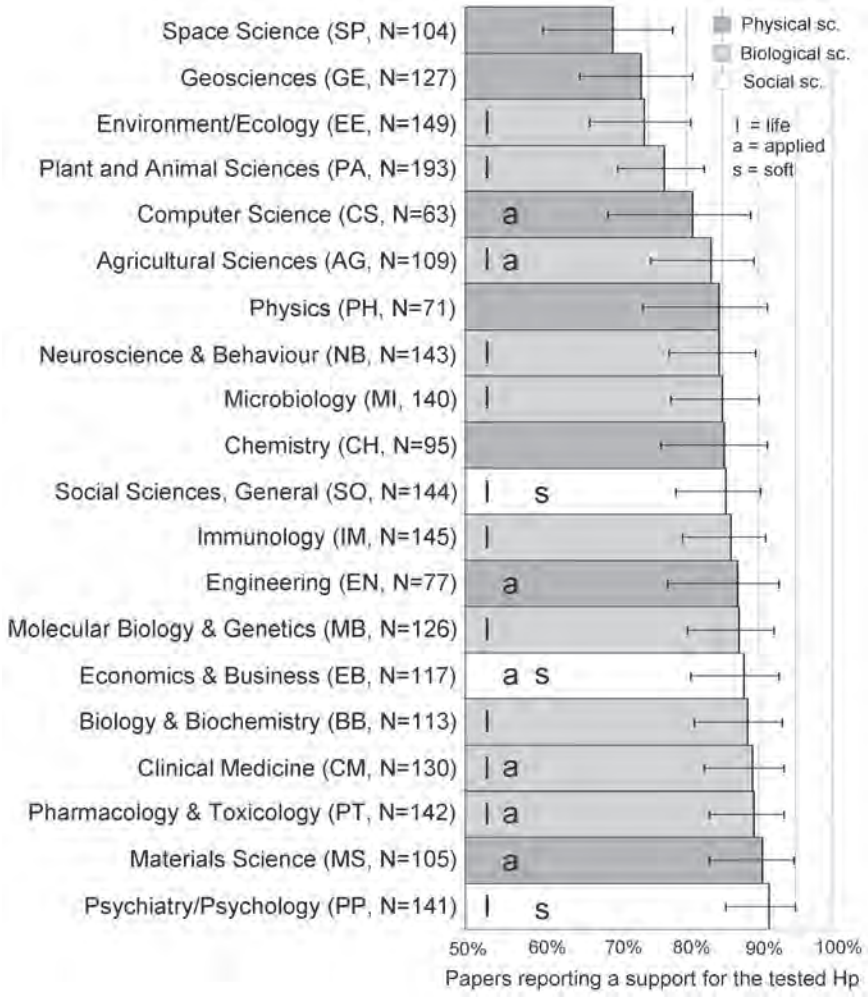
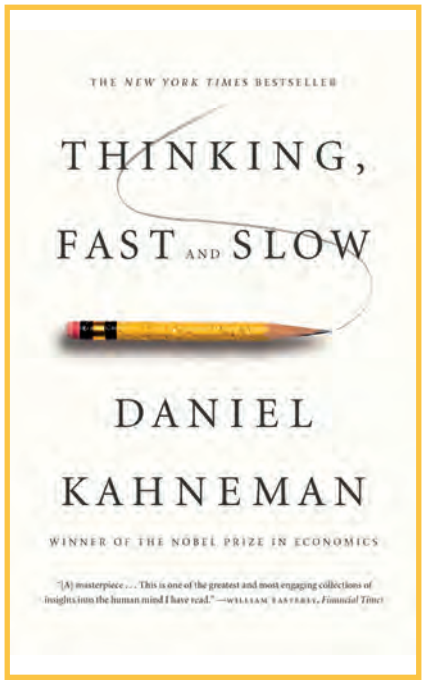


Figure 2. A graph from Fanelli (2010) showing the percentage of published papers from twenty different fields of science that reported support for the tested hypothesis.

The Doyen et al. (2012) article provoked a blistering response from John Bargh on his *Psychology Today* blog. (The post has since been removed but is preserved on the Open Science Framework website at https://osf.io/73a5f.) But this was not the only blow to priming research. A few months before the Doyen et al. (2012) study appeared, a committee at Tilburg University in the Netherlands released an interim report on psychologist Diederik Stapel, a rising star in the priming field (Achenbach 2011). Tipped off by several young researchers who had worked in his laboratory or had knowledge of his research, the committee found evidence of a shocking level of research fraud. Stapel ultimately admitted to fabricating data on a total of fifty-eight different publications. The website Retraction Watch, which monitors cases of research papers being retracted by their authors or publishers due to fraud or error, reported on Stapel's most recent retraction in 2015 (Palus 2015). At that time, Stapel was listed fourth on Retraction Watch's "leader board" for researchers with the most known retracted papers. He has since dropped to seventh.

Meanwhile the broader reexamination of published psychology studies chugged on, and additional priming studies were among the experiments that fell from glory. For example, in a very large-scale replication effort called Many Labs 2, rigorous replications were attempted for twenty-eight classic and contemporary published studies, and the authors found that only fifteen of the replications (54 percent) produced significant results similar to the original studies (Klein et al. 2018). Among the studies that could not be reproduced

Daniel Kahneman (Wikimedia)



were three priming experiments. For example, one experiment used a scrambled sentence task similar to Bargh's 1996 study. People in one group were primed with words suggesting "heat" and in another with words suggesting "cold" (Zaval et al. 2014). Subsequently, people in the heat condition expressed significantly greater belief in and concern about global warming than those in the cold priming condition. Unfortunately, a more rigorous replication of the study as part of the Many Labs 2 project came up empty: no significant differences between the heat- and cold-primed groups.

Daniel Kahneman was moved to write his 2012 open letter about the priming "train wreck" because he had been personally burned by it. Although he was not actually a priming researcher, in his 2011 bestselling book *Thinking, Fast and Slow*, he had included a section titled "The Marvels of Priming," in which, among other examples, he described Bargh's elderly stereotype study at some length. Unfortunately, soon after the book appeared, things began to unravel, and it looked like priming research might follow the ignominious path of subliminal messages: a lot of excitement followed by a burst balloon. A decade has passed since Kahneman wrote the open letter, but it appears he is still down on the field of priming. In a 2022 online lecture for Edge.org, he said, "And behavioral priming research is effectively dead. Although the researchers never conceded, everyone now knows that it's not a wise move for a graduate student to bet their job prospects on a priming study" (Kahneman n.d.).

Part of what bothered Kahneman was the remarkably defensive response of priming researchers, particularly John Bargh, as exemplified by Bargh's *Psychology Today* blog post. In Kahneman's view, priming researchers had shown a disappointing reluctance to attempt to reproduce their previous results, in sharp contrast to Kahneman's research philosophy. Like most academic psychologists, Kahneman has had his share of disagreements with other researchers, but unlike almost all other academic psychologists, Kahneman has sought to engage with his rivals in an effort to find a sensible resolution. The subject of his Edge.org talk was "adversarial collaboration," a strategy in which researchers who are at odds with each other agree to collaborate on the design of experiments that they both acknowledge have the potential to resolve the issues at hand. Kahneman has used this approach on a couple of occasions, but he admits that it has not always worked. It is difficult to change people's minds. But the impulse to try to solve the problem by cooperatively seeking out more information seems far superior to entrenched positions and academic warfare. In my view, Kahneman's gentle manner and his "make love not war" approach to scientific conflicts are two of the many reasons he is held in such great esteem.

How This Happened

I think I know how this happened, at least in broad strokes. Part of the explanation is reflected in Kahneman's section title "The Marvels of Priming." These studies are a bit mind-blowing and, as a result, guaranteed to grab attention. Indeed, some of what made control by subliminal messages so scary to the general public is precisely what makes priming studies so attractive for researchers. First, the control is unconscious. We tend to think of ourselves as being in control of our actions. The prospect of being controlled by someone else without our knowledge or consent is quite unsettling. On the other hand, psychology researchers are likely to be thrilled about the prospect of nudging us toward French or German wine without our awareness.

The second factor, in my view, is the outsized power of priming effects. Typically, a very subtle stimulus—a few words in a scrambled sentence task or background music in a wine store—produces a much larger effect in the unsuspecting participants. This kind of power is intoxicating and bound to get attention. In a recent article, Jeffrey Sherman and Andrew Rivers described the most controversial studies as "eye-catching and counter-intuitive," as well as "the kind of sexy research that popular science writers love to describe" (Sherman and Rivers 2021, 6). The prospect of your research creating publicity buzz would also be a powerful incentive in favor of positive results.

These factors don't explain the defensiveness of priming researchers, except perhaps that psychologists might be reluctant to cast aside studies that bring

them a lot of attention. But for whatever reason, some priming researchers did respond defensively, and this did not serve to quell the controversy.

Is Priming Dead?

So, is priming research really dead? In one sense it is, and in another it isn't. In Kahneman's sense, priming research is probably dead—at least for the time being. The field is still so fraught with controversy that few young researchers, not yet safely ensconced in tenured positions, are likely to risk conducting priming research only to have their work looked at with skepticism or—worse yet—shown to be unreliable someday in the future. For a while, at least, most priming research will be limited to brave and well-established researchers. Also, in no small part due to the influence of Kahneman's letter and the widespread publicity surrounding the problems in the field, priming research in general has a bit of a dark cloud hanging over it.

In a second sense, the reports of the death of priming have been greatly exaggerated. Many studies have stood the test of replication, and the general consensus is that many priming effects are real and likely to influence us in unknown ways every day (Bargh 2016; Strack and Schwarz 2021). Even subliminal priming has risen from the ashes of Vicary's "EAT POPCORN" and "DRINK COCA-COLA" disaster. Recent studies suggest that subliminal stimuli, below the level of conscious awareness, *can* influence behavior—but in a far more modest fashion than first imagined. For example, Johan Karremans and colleagues (2006) found that subliminal priming of a particular brand (e.g., Lipton's Iced Tea) could influence the brand of drink chosen, but only in participants who were already thirsty. Thus, consumer research suggests that subliminal messages can't make you do things you aren't already motivated to do (Bargh 2016).

Furthermore, there is a growing understanding that many of the studies that fell to the Reproducibility Crisis were "under-powered" studies with relatively small sample sizes and weaker experimental designs (Sherman and Rivers 2021). The more stringent standards that have emerged in recent years in response to these issues should lead to more reliable results in the future. In particular, the relatively new movement called "open science" has promoted more collaborative and transparent methods in science, and many scientific journals have adopted open science methods as standards or incentives for acceptance of submitted articles (McKiernan et al. 2016). This movement may not solve all the research problems in the priming field, but it can only help. The clouds have not yet lifted, but perhaps before long priming research will be reestablished as a solid and dependable field. ■

The more stringent standards that have emerged in recent years in response to these issues should lead to more reliable results in the future.

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[THE PRACTICAL SKEPTIC MICK WEST

Mick West is a writer, investigator, and debunker who enjoys looking into the evidence behind conspiracy theories and strange phenomena and then explaining what is actually going on. He runs the Metabunk forum, tweets @mickwest, and is the author of the book *Escaping the Rabbit Hole*.

Hairdryers and UFOs

I first became aware of the crosshairs mark phenomenon while watching an interview with Stanford scientist Garry Nolan, who gave an account of a UFO sighting that mysteriously did not show up in photographs.

Interested, I looked up the case and found a presentation by legendary UFO researcher Jaques Vallée (Vallée 2020). The disappearing UFO part of it was discussed, but what caught my attention was that the witness had, eight months earlier, discovered a strange mark on her hip. It looked like the image in Figure 1.[1]

It was described as a "crosshair," although it was only a part of one. Vallée's next slide showed an array of similar marks that had apparently been found by people (mostly women) around the world. They all looked something like a crosshair, with two or more concentric circles and a variety of lines radiating out from the middle.

At this point, I read the comments below the video. One of them pointed out that the shape of the marks resembled the front of a hairdryer. Aha! I thought, pausing the video. That was all it was. Vallée had simply overlooked this very straightforward explanation. The mark on the woman in Vallée's presentation did indeed look like a superficial burn that was a few days old. It, and the other images, also quite closely resembled the front grills of a variety of hairdryers.

So I started to do some research. I googled "Hairdryer burns" and found a paper in the *International Journal of Legal Medicine* that showed a very similar image. I posted this on Twitter, with a comment (perhaps overly flippant) about how Vallée was mistaking hairdryer burns for messages from interdimensional tricksters. (Vallée does actually propose interdimensional tricksters as the cause of a variety of phenomena.)

But Wait, There's More!

I then watched more of the hour-long video. A few minutes after declaring the marks a mystery, I was surprised to hear Vallée actually address the hairdryer hypothesis:

> Look at the end of the hairdryer, it looks like [the mark] ... So maybe she burned herself with her hairdryer. Well, if you try to do that, you're going to get burned, alright. But it's not going to look like this. Okay, you will have a burn. And so, so it's not that. Although in some cases, the dimensions are pretty much the same as the ones on the grid in the front of your hairdryer. But it's not always the same pattern.

So Vallée was in fact aware that the

Figure 1. The type of mark presented by Vallee

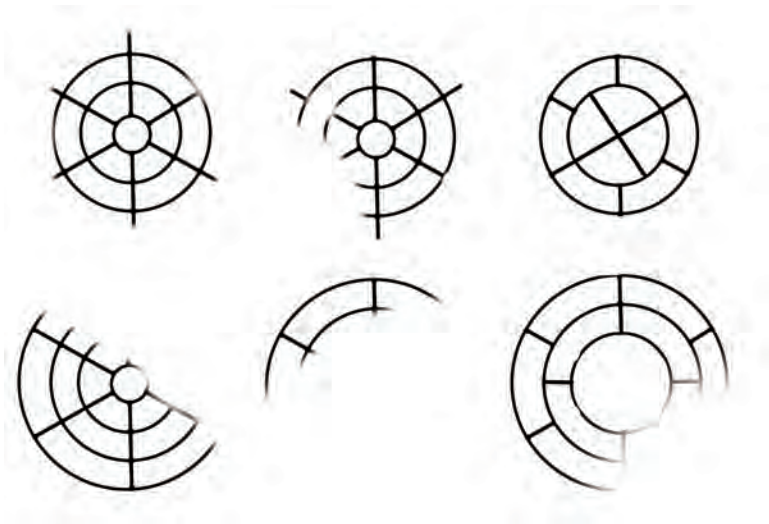

Figure 2. Typical variations in crosshair marks

patterns match hairdryers but dismissed it with two objections: "It's not going to look like this," and "It's not always the same pattern."

I started to dig a little deeper and began to utilize my favorite tool: crowd-sourced research. Many hands (and eyes) make light work, especially when it comes to finding things. Vallée had said, "We've got cases from across the globe in every country." But where are those cases? I started a thread on Metabunk.org and asked the internet (West 2022).

We found a few examples searching using English but hit gold after switching to French. We arrived at an old-fashioned discussion forum called "Touraine Insolite: Mystères & Etranges" ("Unusual Touraine: Mysteries & Strange Things"). Touraine is a province of France, and the site focuses locally on "the mysterious, UFOlogy and the paranormal" (Mikerynos 2013).

Somehow this site had become the worldwide hub for "Étranges traces circulaires cutanées" ("strange circular skin marks"). A single thread (and accompanying database) documented over 250 cases between 2013 and 2022. The cases were often illustrated with photos and accounts from the marked.

Figure 3. Marks created with a hairdryer and ink

Hairdryer? *Non*!

The first cases did not mention hairdryers. But because it's such an obvious explanation, it quickly emerged. Later cases joked about it or expressed suspicions of hairdryer involvement. Eventually we got to case sixty-nine, where they described waking up and finding the mark on their shoulder, and they could not imagine how they got it. But three days later, they decided "with certainty" that it was the hairdryer.

The site then amended the questionnaire, now asking 1) if they use a hairdryer, 2) what model it was, and 3) did they have a photo of it. While most people said they owned a hairdryer, very few people even answered the next two questions. But some did, and some realized their marks were from hairdryers.

Unfortunately, even there, the site administrator communicated with the person and attempted to convince them that this was unlikely, describing it as a "réaction sécurisante" ("reassuring reaction")—i.e., a reaction that made the person feel good but was not correct. They pointed out the lack of remembered pain and other people having similar marks. Neither of which, as I later discovered, are valid objections.

Time for Experiments

The hairdryer hypothesis seemed very sound. The marks looked like the front grills of hairdryers, and some people had found such marks and determined that they *were* from hairdryers. Yet most of the cases either did not even consider it or they rejected it, saying they would have remembered such a painful burn.

Would they, though? Not willing to experiment full scale (and full pain) I hit upon a safer experiment. I used a rod-shaped thermocouple to measure the temperature at the grill by placing it just inside the hairdryer. I saw the temperature quickly rise to 75°C (167°F), where it stabilized. This did not seem that hot, so I grabbed the thermocouple and pressed the heated end into the skin of my arm.

There was a brief jolt of pain that vanished in a second, as you might get from touching food hot out of a microwave. The skin initially appeared unchanged, but after a few minutes a redness appeared in the shape of the thermocouple—a short line on my arm.

I watched the mark, photographing it every day. After two weeks it was still visible. It looked the same color as many of the marks seen in the database.

This showed that it is entirely possible to burn yourself with not much pain. Your skin would show no damage (if you even checked). The burn mark, painless, would show up a little later, by which time you may have dressed. Then you might not notice it for hours or even days. By that time, you could easily have forgotten such an inconsequential event, especially if there were a lot of other things going on.

Science and Hairdryers

What does it take to get such a burn? There's actually a variety of factors that come into play other than temperature. The most significant is the thermal conductivity of your skin (basically how thick and dry it is). But the danger zone for first-degree (superficial) burns starts at around 70°C—about where my hairdryer (and thermocouple) were. So the small burn I got was probably representative of many actual hairdryer burns.

I studied the grills on the front of hairdryers. One of Vallée's objections was that "It's not always the same pattern." But of course, there are quite a variety of different grills on the front of hairdryers. There are different numbers of circles and spokes, and they occur in a variety of combinations—so different patterns are expected.

In addition, I noticed that the grills are often slightly domed. The areas of skin where the marks were found were often rounded. A firm curved surface coming into contact with a soft curved surface might result in a variety of contact marks—either just the center, sometimes half the pattern, or sometimes just the edge. I used an ink pad to ink the grill on my hairdryer and quickly pressed it against my leg in a variety of ways. I got several marks, all

from the same hairdryer, that looked very different.

If the Hairdryer Fits

The uniqueness of Vallée's UFO case, as he presented it, hinged partly on the existence of this earlier mark on the person. Luckily, she had also submitted it to the database and answered the questionnaire. "Oui," she said to the hairdryer usage question and "Silvercrest (Lidle)" to the question about the model. She did not have a photo of it, but it took little time to track down a typical Lidle Silvercrest and get an image of the front grill. I overlaid the photo of her mark, and it was a perfect match.

So she had what looked like a superficial burn (like my nearly pain-free burn) that seemed like it was a few days old and was an *exact* match for a partial skin contact with a hairdryer that matched the description of the one she owned. By far, the most reasonable explanation is that she simply did not remember burning herself. The mark is probably nothing special and unrelated to the later UFO case.

I emailed Vallée and Nolan, sharing my findings and seeking comments for this article. Vallée replied, saying he agreed with my interpretation about this particular case and had in fact done similar research in the past. Like me, he had found that many of the marks resembled hairdryer burns, and some were conclusively demonstrated to be from hairdryers. Nolan said they did this type of research at least eight years ago. This left the obvious questions of why Vallée was still using this mark as somehow relating to a UFO encounter in a 2020 presentation and why he seemed to casually dismiss the hairdryer hypothesis later in his talk.

Vallée said he had "removed certain cases from the dataset" but was reluctant to "expose" any individual case, as it "might discourage honest witnesses of more complex cases from coming forward." He also expressed concern that the invalidation of the mark might cause the Skeptical Inquirer readership to use it as an excuse to dismiss the UFO photo. I pointed out that the witness remained anonymous, and the SI audience was unlikely to give a UFO photo much credence regardless.

The exchange reflects our differing philosophies and an issue with communication. I like to investigate individual cases and explain them if possible. Vallée also does this examination but prefers to keep the explanations private because it's the big picture that's important. Like many people in the UFO community, he sees the debunking of an individual case as resembling an attack on a broader argument. That is not my intent. Sometimes a hairdryer is just a hairdryer, but that does not mean we are not being visited by aliens. That's a different discussion. ■

Note

1. All the images that accompany this article are simulated.

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[SKEPTICAL INQUIREE BENJAMIN RADFORD

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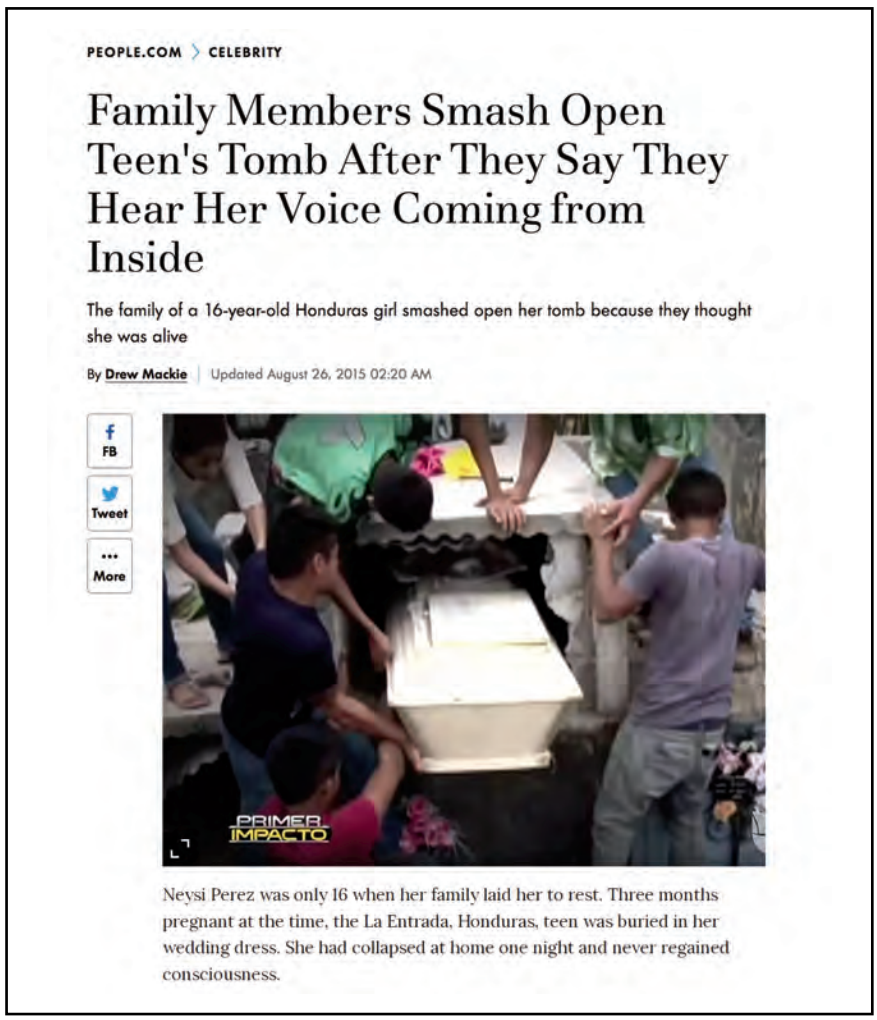
Buried Alive in Brazil: Modern Premature Burials

Q: **While researching stories of people seemingly coming back from death, I found a terrifying case of a Brazilian woman who was buried alive. How would you explain this?**

—S. Goldie

A: Being mistaken for dead—and thus prematurely buried—is a primal human fear. It's also fiction fodder for countless authors, from William Shakespeare to Edgar Allan Poe. Though it is a statistical certainty that it has happened in real life to some unfortunate people, establishing the nature and scope of the problem empirically is a difficult task.

Death is not binary but is instead a process that has degrees and nuances. One very rare medical condition that can clinically mimic death is Lazarus Syndrome, also known as "return of spontaneous circulation." This occurs in medical settings when a patient is pronounced dead due to a lack of vital life signs (cardiac activity and respiration) and yet later revives independently. First reported in the medical literature in 1982 and only involving a few dozen cases, explanations offered for this phenomenon include delayed adrenaline effects (administered drugs may not reach the heart for several minutes) and that cardiopulmonary resuscitation (CPR) efforts can diminish blood flow to the heart, and once stopped the heart may spontaneously restart. However, this cannot explain the dead "awakening" hours or days later; all incidents in the literature occurred within ten minutes of stopping CPR. This is one reason that in many cases patients are closely monitored until that point; see Ben-David et al. 2001. Of thirty-eight cases Vedamurthy Adhiyaman and colleagues (2007) examined, half significantly recovered and the other half soon died (again—but permanently this time).



PEOPLE.COM › CELEBRITY

Family Members Smash Open Teen's Tomb After They Say They Hear Her Voice Coming from Inside

The family of a 16-year-old Honduras girl smashed open her tomb because they thought she was alive

By Drew Mackie | Updated August 26, 2015 02:20 AM

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PRIMER IMPACTO

Neysi Perez was only 16 when her family laid her to rest. Three months pregnant at the time, the La Entrada, Honduras, teen was buried in her wedding dress. She had collapsed at home one night and never regained consciousness.

Figure 1. News article from *People* magazine online reporting on the premature burial of Neysi Perez in Honduras

Then there's also the alleged "zombi-

fication powder" that ethnologist Wade Davis discovered, as described in his books *The Serpent and the Rainbow* and *Ethnobiology of the Haitian Zombie* (though his claims were criticized as being overstated and unreplicable; see Stevens 1996). That process was said to make a person appear dead but then able to be revived later as a zombie for use as a laborer.

Premature Burial in Brazil

The case I was asked to investigate occurred in 2018, when a woman named Rosângela Almeida dos Santos died in the small community of Riachão das Neves in the Brazilian state of Bahia. She was thirty-seven when she died of septic shock resulting from emphysema and a severe respiratory infection at a hospital on January 28. She was buried the following day. About ten days after her death and burial, on Friday, February 9, her relatives claimed that she had been buried alive and mistakenly pronounced dead because of a medical error.

Dos Santos's mother reported having repeated nightmares that her daughter was still alive. When residents of houses neighboring the municipal cemetery claimed to hear screams coming from the grave, the family breached her tomb and opened the casket. To their horror, they found that she had turned over in the coffin and had what were described as wounds on her forehead and hands, suggesting she had woken up in the coffin and tried desperately to get out. The family also reported that dos Santos's body was still warm, indicating she'd died only recently (Polianskaya 2018).

The sensational and lurid case made international news and prompted outraged accusations of medical incompetence; an investigation was promptly launched when the public demanded to know how this could have happened. I'd previously investigated a famous case of mysteriously moving coffins (see "Reopening the Chase Vault" in the May/June 2020 Skeptical Inquirer), but this was a new twist. As bizarre as the case was, it wasn't the first time this (allegedly) happened in Latin America. A nearly identical case occurred several years earlier—and offers clues to solving the mystery.

The Mystery of Neysi Perez

A bizarre story from Honduras claimed that a pregnant teen girl was prematurely buried in August 2015, a day after she had apparently died and been pronounced dead. According to a story in the U.K. *Telegraph*:

> A teenage girl in Honduras had mistakenly been buried alive and apparently woke up in her coffin, only to die before she was freed. Footage shows frantic relatives smashing into the concrete tomb of recently buried Neysi Perez, 16, after they said they heard her screaming from inside. She had been buried the previous day. When they opened the coffin, Perez was dead. But according to relatives, she was still warm and had bruises on her fingertips. The glass viewing pane on her coffin had been smashed. (Quoted in Roper 2015)

Her husband, Rudy Gonzales, told *Primer Impacto* TV news, "As I put my hand on her grave, I could hear noises inside. I heard banging, then I heard her voice. She was screaming for help. … I couldn't believe it. I was ecstatic, full of hope." He and others immediately began removing the coffin from the above-ground tomb, breaking into the concrete and coffin with hands and hammers. Perez was then rushed to a hospital in the nearest city, San Pedro Sula, where according to Dr. Claudia Lopez, "The whole family rushed in, almost breaking the door down, carrying the girl in her casket. I told them to take her out and put her on the bed. Everybody was claiming she was alive so I went through all the necessary procedures. We evaluated and tried everything but the girl was dead" (Radford 2015).

Though there are some missing details in this strange case, there's enough information to suggest a plausible explanation: the faint, muffled "scream" heard seemingly coming from Perez's above-ground tomb was not a scream at all but instead some ambient urban sound (perhaps car brakes squealing in the distance or a siren's wail) interpreted by the girl's grieving family as a cry for help.

Despite sensational news reports that Perez was "screaming" and "banging" on her coffin, there's simply no evidence of that beyond the (surely sincere but likely mistaken) claim by her husband. Once he began, quite understandably, panicking that his wife may have been buried alive, the others joined in. Hearing a dead loved one's voice is common and harmless, especially in the early stages of grief or panic. Illusory voices and signs of life can be created by a well-understood psychological process called apophenia.

The phenomenon of hearing (or more accurately, *thinking* we hear) nonexistent human voices is more common than most people realize. If we think we hear someone calling to us and we realize we're mistaken, we just laugh it off as the ordinary, insignificant misperception that it is. However, that same thing takes on a very different meaning and interpretation in the context of grief and graves. There are many reported cases in which what sounds to a listener very much like a person speaking or calling out to them is in fact merely an auditory illusion. Many ambient sounds can at times sound like a human voice, cry, moan, or wail—including wind whistling through trees or over bridges, old radiators warming up, trains, insect calls, and so on. For a more complete discussion of this phenomenon—including its relevance to ghost hunter "ghost voice" EVPs—see chapter 7 in my book *Investigating Ghosts: The Scientific Search for Spirits*.

A closer look reveals no evidence suggesting that Perez was not (still) dead when her family broke into her coffin; she appeared calm and nonresponsive in the videos. By all accounts, she never moved, opened her eyes, or spoke, and there were no doctors present. Her family seemed to assume she had—apparently up until moments before—been alive and screaming because her body was warm and pliable. But there's no reason that Perez's body would have been cold; Honduras is located in the Central American tropics, and unless she had been kept in cold storage for some reason (such as an autopsy), it would have been ambient temperature (ranging from eighty to ninety degrees Fahrenheit, depending on the time of the burial). Her body was flexible because rigor mortis is only

Woman 'buried alive spends 11 days trying to fight her way out of coffin'

Comment

Joe Roberts
Friday 16 Feb 2018 4:23 pm

Her family smashed open the stone tomb but it was sadly too late (Picture: Globo G1)

A woman was reportedly buried alive and left to lay conscious inside her coffin for eleven days.

Her family smashed open the stone tomb after locals heard screams coming from the grave, but it was sadly too late.

Figure 2. News article from the *Metro* tabloid online reporting on the premature burial of Rosângela Almeida dos Santos in Brazil

temporary; eight to twelve hours after death, bodies normally lose their rigidity as muscles relax.

Relatives also claimed to have seen bruises on her fingertips (which could have come from anything) and that a viewing glass in her coffin had been "smashed" (though news video clearly shows a single break in the pane, which could have happened when her relatives urgently broke into her coffin with a hammer). Had Perez been desperately beating against the top of her coffin from inside in a panicked bid to get out, it's likely all the glass would have been broken and her hands cut.

Neysi Perez's reburial has strong parallels to vampire accounts from the early Middle Ages in Europe, in which villagers would sometimes exhume the recently buried dead and come to believe that the deceased were vampires, mistaking ordinary decomposition processes for signs of recent life and movement. Death isn't like we see in the movies, and most people have no real-world experience with post-mortem bodies. For those who are unfamiliar with forensics, the ordinary details of death may seem unexpected and mysterious, especially by people in the grip of grief, fear, and hope.

Roângela Almeida's Return to the Grave

Returning to Brazil and the case of Rosângela Almeida dos Santos, we can see a virtually identical situation. The police investigation concluded that "the situation reported by family members [was] not supported by any plausible evidence" and that the family, while surely sincere, had acted on misunderstandings and rumor (G1BA 2018). The police also found a medical explanation for why the body was not in a greater state of decay: "the use of antibiotics during hospitalization and rainy weather favored a slower decomposition" (G1BA 2018). All the evidence suggested that, thankfully, there was no medical mistake; Rosângela Almeida dos Santos had not in fact been buried alive for ten days (in any event even if she had, the lack of food, air, and water would have killed her soon after burial). In a curious coda to an already strange case, dos Santos's family was later charged by police with violating her grave.

There have been documented incidents in which people presumed dead have later been found to be alive, often in rural areas or third-world countries in which a conclusive medical determination of clinical death is impractical, unnecessary, or simply not made. For example, a great many deaths in India happen in private homes, and the dead are simply buried without medical examination or formal declaration of death. ■

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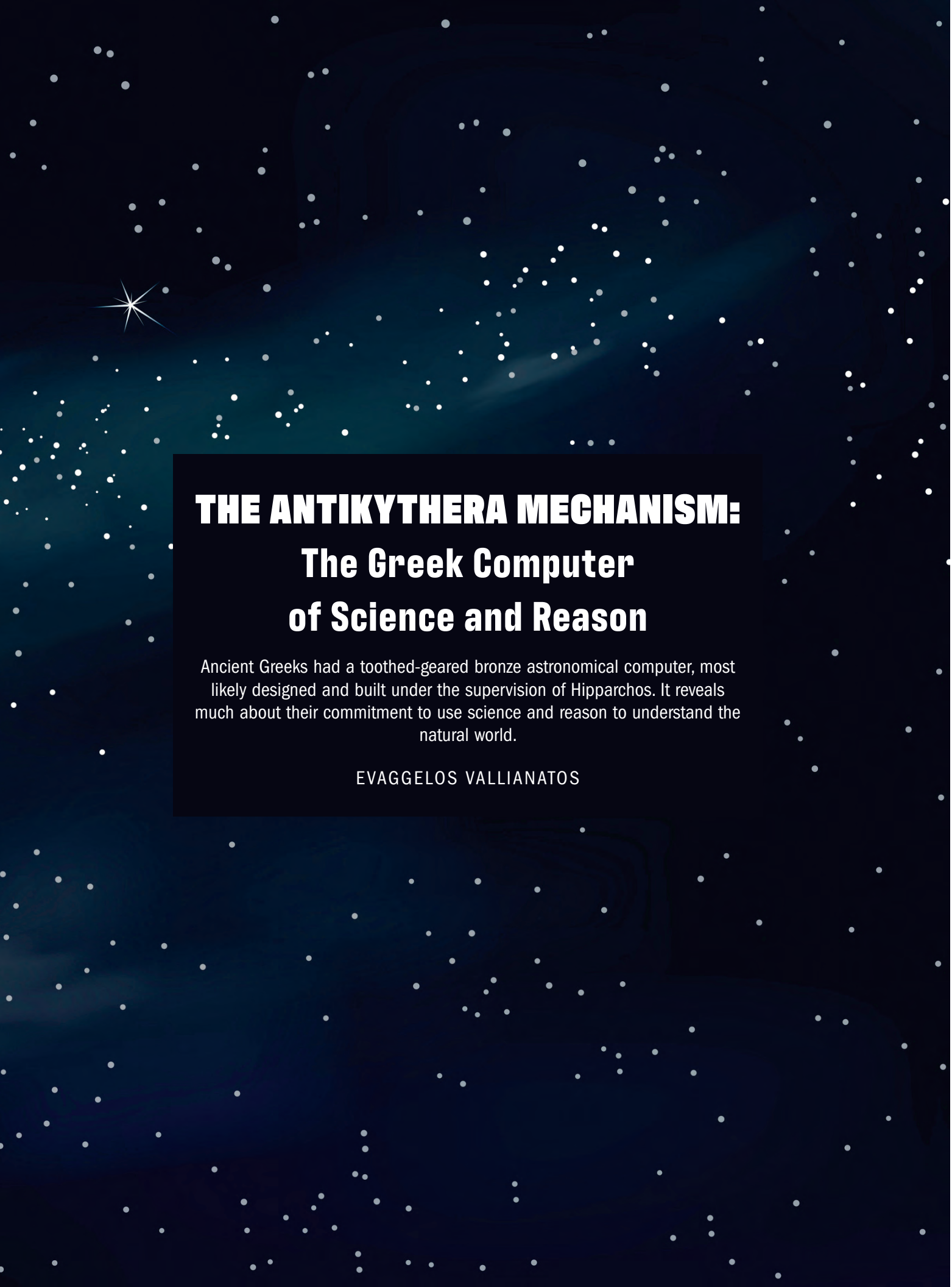


THE ANTIKYTHERA MECHANISM: The Greek Computer of Science and Reason

Ancient Greeks had a toothed-geared bronze astronomical computer, most likely designed and built under the supervision of Hipparchos. It reveals much about their commitment to use science and reason to understand the natural world.

EVAGGELOS VALLIANATOS

The Antikythera Mechanism, painting by Dionysios Kriaris, a mathematician living in Athens. Courtesy of Kriaris via the author.

In 1900, Greek sponge divers discovered a sunken ship off the coast of the island of Antikythera. The ship was full of Greek treasures, including the remnants of a computer dubbed the Antikythera Mechanism. Scientists have been studying this geared device ever since. Their consensus is that this tooth-geared bronze astronomical computer is a machine of science and reason, most likely designed and built on the island of Rhodes under the supervision of Hipparchos, the great Greek astronomer of the second century BCE. The Antikythera device was a predictive computer of natural phenomena and human events.

Prologue

In 2007, I saw for the first time a few fragments of the Antikythera Mechanism at the National Archaeological Museum in Athens. I kept looking at them from all possible angles, trying to figure out their significance. I left the museum delighted and eager to learn more about this ancient yet modern-looking mechanism. "Imagine," I kept telling myself, "my ancient ancestors designing such an astronomical computer with gears, the kind of gears we have in the twenty-first century in countless machines, including cars and airplanes?"

Once back in the United States, I read voraciously about this device. The articles and few books I could find dedicated to the Antikythera Mechanism examined primarily the modern decoding of the machine. But that, however interesting, did not satisfy me. I wanted to know how and why Greeks 2,200 years ago would embark on this epochal science adventure of building a machine capable of predicting both natural phenomena and human events, such as the Olympics. The result of my curiosity and research was writing my own book (Vallianatos 2021), in which I explained both the history of Greek science and technology and the modern history of decoding the computer. I worked on this book for several years, so my narrative covers a lot of ground from mythology, cosmology, philosophy, science, and politics to the building of the computer. Nothing like the Antikythera computer appeared in Europe before the eighteenth century.

Some of us, myself included, like to believe we see with the eyes of the Greeks. But is that possible? The Greeks were children of polytheism, and most of us (but not me) are children of monotheism. Yes, the Renaissance made us as much as the Greek books of Plato, Aristotle, Euclid, Aristarchos of Samos, Archimedes, Hipparchos, Ptolemy, and Galen made the Renaissance.

Greek Gods

The gods meant a lot to the Greeks, including those who made the Antikythera computer. Greek religion/piety for the gods, however, had no sacred texts, dogmas, or priestly class. The oracle of Apollo at Delphi was an outstanding policy institute with enormous power. The Lydian kings Gyges (c. 680–645 BCE) and Croesus (560–546 BCE) respected the integrity and truthfulness of the Greek oracles and gods. They brought so much gold and other precious gifts to the god Apollo at Delphi that the polis of Delphi gave citizenship to any Lydian who requested it. No Greek polis would start a home outside mainland Greece or undertake anything significant such as war without consulting Pythia, the priestess of Apollo at Delphi. In fact, even when Greek armies were facing their enemy, which could be other Greeks or foreigners, they first asked their diviners to look at the entrails of the sacrificial animal for good omens from the gods before they went into battle.

Laws and Reason

In addition, laws and reason governed the Greek gods and the cosmos. The English classical scholar Hugh Lloyd-Jones said that the Greeks set "the foundations of most of the chief arts of civilization" primarily because of their gods who gave them "the notion of a cosmos, a universe regulated by causal laws" (Lloyd-Jones 1983, 179). The American writer Henry Miller also saw the gods right in the Greeks' great vision. "The gods," he said, quite perceptively, "humanized the Greeks" (Miller 1941, 236).

The Greek cosmos was open to investigation. That is why the Greeks began asking questions, explaining natural phenomena with data and reasonable theories they formulated from their careful observation of the workings of the natural world. That was the beginning of science. Galen—Greek

scholar, philosopher, and great physician of the second century—said that mortals have something in common with the gods, and that is reason (Galen second century BCE).

Rise of Science

The gods, and the universe those gods represented, demanded that the Greeks understand their power, which meant an understanding of nature and the cause and effect of phenomena in the natural world and the universe. They knew, for example, that (1) Hephaistos, son of Hera, was fire—the all-devouring, all-taming, and all-haunting part of the universe. Hephaistos—the god whose craftsmanship sparked metallurgy in Lemnos and Caucasus—was the eternal artisan who brought light to mortals. This was the god who enabled humans to see the ether, the Sun, the stars, the Moon, and pure light through him. Hephaistos, the god of fire, was reason in the Cosmos and in the world of men and women (Orphic Hymn to Hephaistos 66 [Athanassakis 1977]); and (2) Nomos—a cosmic principle—was all about reason and order in the cosmos (Orphic Hymn to Nomos 64 [Athanassakis 1977]).

Mythic Models for Science

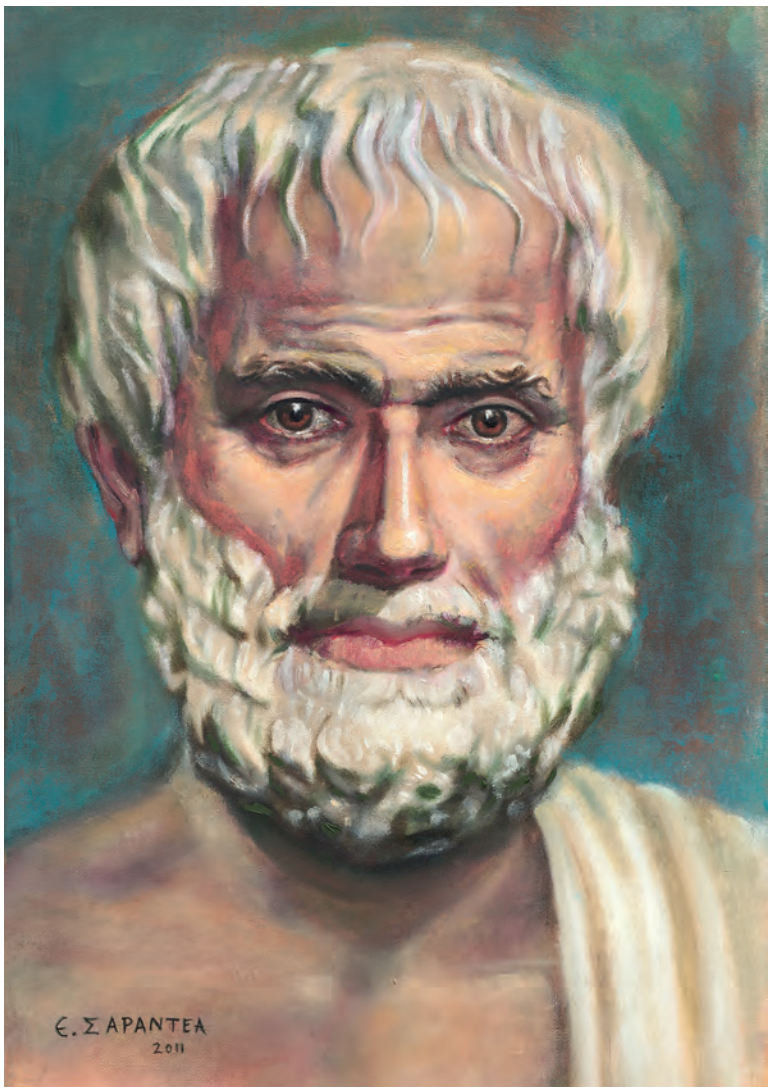
Mythology and the gods connected to science and technology (Prometheus, Atlas, Athena, and Hephaistos) provided models for craftsmanship and *techne*, which became the infrastructure of science and technology. Theoretical ideas were tested. For example, I studied zoology at the University of Illinois, but that whole science was abstract. The moment I read Aristotle's zoological works, I understood animals at a much deeper ecological and social level; Aristotle made sense of zoology for me.

Aristotle and Alexander the Great: From Theory to Objective Knowledge

Science received a boost from Aristotle, who tutored Alexander the Great. The young conqueror of Persia materialized Aristotle's universe: poleis (city-states) full of schools and libraries, with scientists studying and understanding the phenomena of the cosmos and society. This took deep roots in Egypt because its first king was a general of Alexander and a student of Aristotle. This was Ptolemy I the Savor (323–283 BCE) who founded the Mouseion (temple of the Muses, goddesses of learning) and the great Library of Alexandria. The Mouseion and the Library opened their doors to the best minds of the Greek world, triggering a golden age of Greek science, lasting from the fourth to the first centuries BCE.

Lucio Russo, Italian mathematician and historian of science, concluded that from the late fourth to the late second century BCE, the Greek-speaking countries brought into being "an explosion of objective knowledge about the external world" (Russo 2003, 1).

The Antikythera astronomical computer came out of that explosion of light and Enlightenment. It stood on the shoulders of philosophers and scientists such as Eudoxos, Aristotle,



Aristotle, painting by the Greek artist Evi Sarantea. Courtesy of Sarantea via the author.

Euclid, Aristarchos of Samos, Apollonios of Perga, Ktesibios, Archimedes, Hipparchos, Poseidonios, and Geminos. Its complex interlocking gears were one of the many groundbreaking contributions of Ancient Greek culture and form the basis of much modern technology.

Archimedes Moved the World

The scientist who set the foundations of science in the Alexandrian Era in the third century BCE was Archimedes. He was a genius who advanced the philosophy of another earlier genius named Pythagoras, who insisted on the understanding of the natural world and the cosmos in the application of mathematics. Archimedes invented a variety of machines and fields of science such as hydrostatics, combinatorics, and mathematical physics. His writings were essential for the rebirth and evolution of science in modern times (Paipetis and Ceccarelli 2010). Since the Renaissance, scientists have been looking up to Archimedes. He is the "model and ideal" they try to "follow and attain" (Dugas 1958, 18).

Archimedes wrote a book called *Spheres*, now lost. He

Toothed bronze gears of the Antikythera computer. Painting by Evi Sarantea. Courtesy of Sarantea via the author.

probably described the making of mechanical universes such as can be achieved with the Antikythera Mechanism. So, Archimedes is the closest father of the Antikythera device, though the Romans assassinated him in 212 BCE, a few decades before the construction of the computer.

Hipparchos

Hipparchos, the real scientific father of the Antikythera machine.

The real scientific father of the Antikythera machine is Hipparchos, the greatest Greek astronomer of the second century. He had a laboratory in Rhodes, where the mechanism came into being. He developed his own astronomical data but also used data from the Babylonians. He invented plane trigonometry and mathematical astronomy. He theorized that the Moon moves around Earth in an elliptical orbit. He succeeded in reproducing this movement in the Antikythera computer. He took two gears and put one over the other, connecting them with a pin-and-slot mechanism. The lower gear moved in a steady speed while the upper gear moved faster and slower imitating the Moon, speeding when close to Earth and slowing down when far from Earth. This added to the accuracy and scientific technology of the Antikythera astronomical computer.

Studying the Antikythera Mechanism: Derek de Solla Price

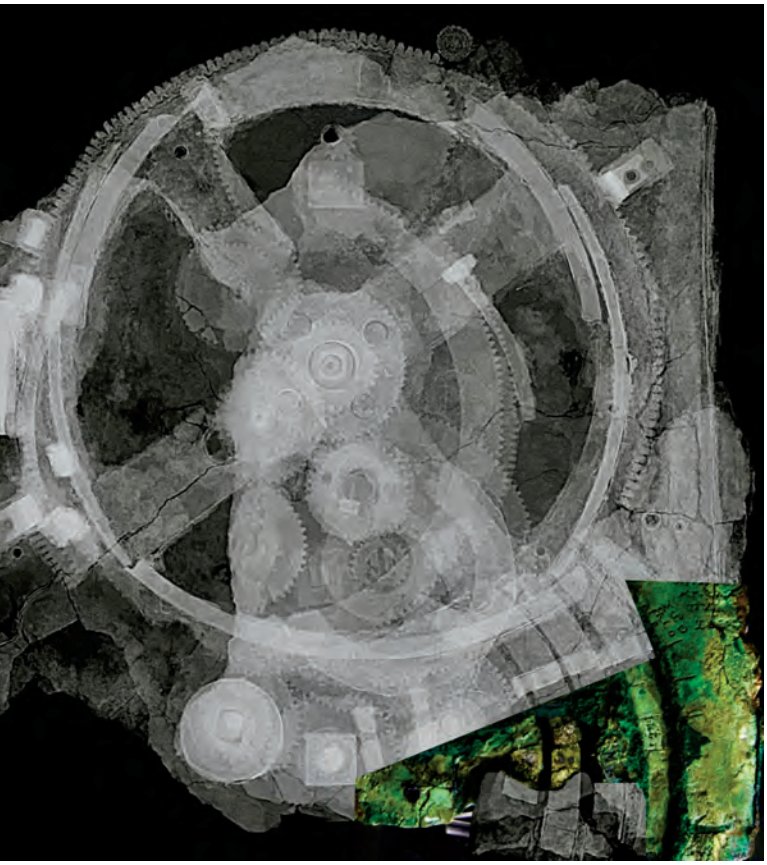
Many scientists studied the Antikythera Mechanism. I found Derek de Solla Price the most insightful and philosophical. He was a physicist and historian of science from Yale. He spent sixteen years trying to understand the world's first computer. His 1974 report, *Gears from the Greeks*, made clear that Western scientists and scholars must reeducate themselves about the Greeks: updating and harmonizing their views in accord with the findings from the study of the Antikythera Mechanism.

Despite the indifference of the scientific community, Price wrote that the Antikythera Mechanism was a "singular artifact" and "astronomical or calendrical calculator" that turned out to be "the most enigmatic, most complicated piece of scientific machinery known from antiquity. … [Moreover, the Antikythera Mechanism is] one of the most important pieces of evidence for the understanding of ancient Greek science and technology." He explained why: The complex gearing of the Antikythera Mechanism shows a more precise picture of the level of Greco-Roman "mechanical proficiency" than that coming out of the surviving textual evidence: "This singular artifact," he said of the Antikythera Mechanism, "the oldest existing relic of scientific technology, and the only complicated mechanical device we have from antiquity, quite changes our ideas about the Greeks and makes visible a more continuous historical evolution of one of the most important main lines [of science and technology] that lead to our civilization" (Price 1974, 5, 13).

The blunt language of Price and his insistence that the Greeks had developed advanced technology did not sit well with several researchers also working on the Antikythera Mechanism. They accused Price of inaccurate assessment of the ancient device. However, other scientists who studied the Antikythera Mechanism in 2005 supported Price and also concluded it was a computer of scientific technology.

Decoding, 2005

Despite the unwillingness of those with power to take Greek history seriously, during the first decade of the twenty-first century, about twenty scientists from England, Greece, Germany, and the United States became receptive to the Antikythera Mechanism and, possibly, to ancient Greek thought. One of those scientists is Xenophon Moussas, professor emeritus of space physics at the University of Athens. He and I became friends. He sent me dozens of photos of the 2005 decoding of the Antikythera Mechanism in the basement of



Back view of Fragment A. Courtesy of X-Tek Systems and Antikythera Mechanism Research Project. The Greek researcher Aristeides Voulgaris modified the image.

the Archaeological Museum in Athens. His work has been of incalculable value in our understanding of the device, which he described as "the epitome of Greek philosophy, *techne*, and science." He even said the Antikythera Mechanism was "a miracle of science, technology and philosophy."

Indeed, this Greek computer was a complicated astronomical device that worked on the basis of theories of physics and astronomy. These theories, Moussas says, mirrored exact mathematics, reproducing natural phenomena such as the movements of the planets in relation to Earth. In addition, Moussas argues that such theories followed the "theory and practice of Pythagoras that the cosmos and nature can only be described by mathematics or, more correctly, by appropriate geometrical constructions using circles, including epicycles. Geometrical constructions with circles are easily made into gears moving dials on panels" (Moussas 2012, 15–43, 103).

Scientific Marvel of Hellenic Civilization

Thus, the Antikythera Mechanism was the culmination of mythology, cosmology, politics, and science among the Greeks. The Library of Alexandria and its sibling institution, the Mouseion, captured that intensive quest for knowledge and its application for the wellbeing of the Greek world. The classical scholar Edward Alexander Parsons, who studied the history of the Alexandrian Library, called it the "glory of the Hellenic world." He is right. The Alexandrian Library was the glory of the Greeks. He said, "The Alexandrian Library was not only the largest and most important collection of Greek books that ever existed, but, in the days of its greatest glory, it was the greatest library in the entire world before the invention of printing" (Parsons 1952, 203).

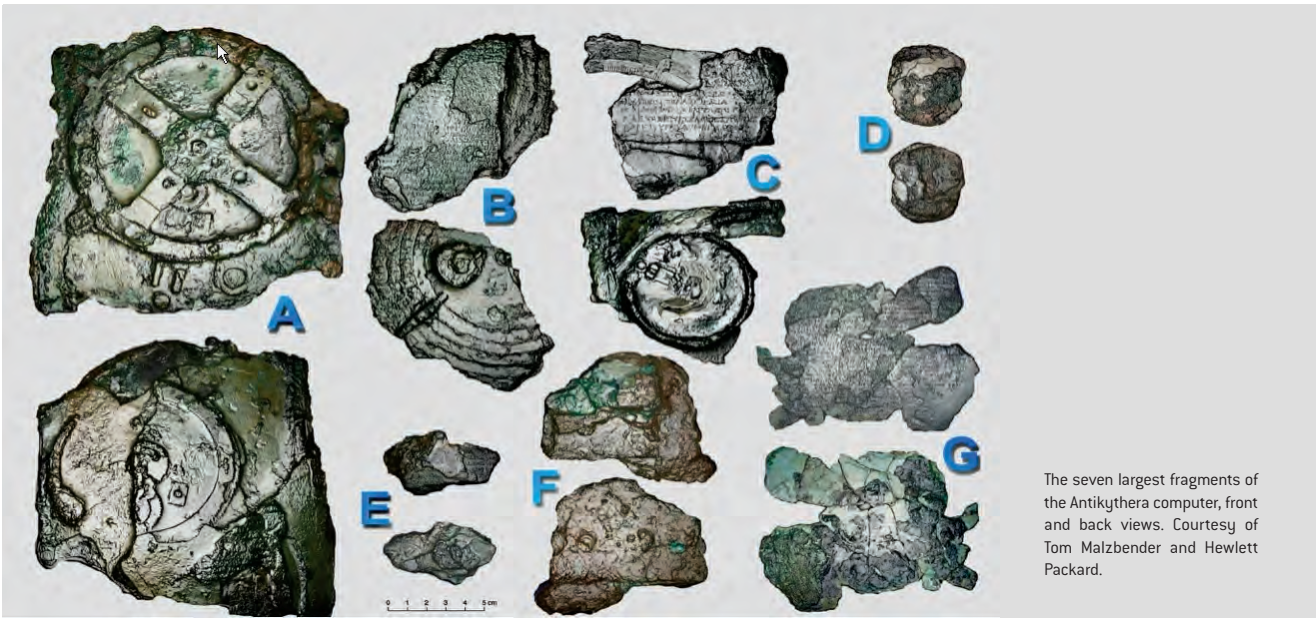
The Antikythera computer was the supreme product of the Alexandrian Library and the philosophy and civilization that the Library represented. That was an age based on knowledge, and the Greeks of that age sponsored and invented modern-like science and technology, sowing the roots of our world.

The Greeks used this computer like a calendar for regulating their agricultural, athletic, and religious responsibilities and work. The Antikythera machine was part of their efforts to read the heavens, and its most important function was predicting solar and lunar eclipses. The Sun and the Moon were very important to the Greeks. Between the two, they had day and night, time, and the seasons. Seeing those celestial bodies disappear was frightening, so predicting those disappearances was fundamental. The Antikythera device also predicted the positions in the sky of the planets, large stars, and constellations; it harmonized their divine and social worlds.

Because of this predictive function, the Antikythera device served as a vital tool for astronomers, farmers, priests, and athletes of the ancient Greek world. It was an instrument of heavens and Earth. It was a creation born out of the ancient Greeks' love and teaching of astronomy and dedication to the practical application of science for farmers, craftsmen, mariners, and those devoted to the worship of the ancient gods through seasonal celebrations, the Panhellenic games, and sacrifices. In many ways, it brought together the temporal and divine spheres of the Greeks. The Greeks had to know the seasons, when to plow the land, and when to sow and harvest the crops. They also needed to know when to offer their sacrifices to the gods at the time the gods expected the sacrifices. The Antikythera Mechanism was designed to give them that knowledge, so it was not just a plaything for rich folk. It was the workhorse of evolving technology and knowledge about the heavens connecting the Greeks to nature, their culture, and the gods.

Influence of Christianity on the Computer's Demise

The Antikythera computer disappeared most likely because Christianity nearly wiped out the Greeks and their civilization. With the burning of the great Library of Alexandria, the shutting down of schools and of the Olympics, and the destruction of the temples, adherents of this new religion drove the rich world of Greek philosophy, science, and technology—such as the Antikythera Mechanism—into the shadows. Existing copies of the device were melted down, and parchment manuscripts became scarce or lost or palimpsests left to be discovered hundreds of years later by scholars. The British scholar Charles Freeman accused Christianity of bringing the dark ages to Europe, when for more than a thousand years serious mathematical and scientific thinking became extinct (Freeman 2004, 340).



The seven largest fragments of the Antikythera computer, front and back views. Courtesy of Tom Malzbender and Hewlett Packard.

Return to the Greeks

The distinguished American academic Allan Bloom urged America educators to return to the Greeks because the Greeks taught wisdom. They were also "the models for modern achievement" (Bloom 1987, 369). Another American, historian, and Librarian of Congress, Daniel Boorstin, reminds us about the need to be in constant touch with the Greeks. The Greeks, he said, represent the best and the greatest the world had to offer. "We are disciples of all of them," he said. "They all have become our contemporaries" (Boorstin 1998, 21). Herbert Golder, professor of classics at Boston University, put it best: "Greek genius is at the root of great achievement. It is also a great wisdom which is at the essence of our most profound understanding of what it means to be human. And its wisdom and it's a legacy that is in jeopardy today" (Golder 2011, 6).

Scientists continue to study the Antikythera computer because it was a practical and sophisticated machine for the public good. It predicted phenomena of nature and important athletic celebrations such as the Olympics, combining them into useful and enlightening revelations of wisdom for a better society and more reliable science. The Antikythera computer is a tool for inquiry, promoting the good and the beautiful. It captures the fifth century BCE Athenian poet Euripides saying in a fragment that those learning how to engage in inquiry deserve blessings because they don't intend to harm their community. Instead, those with the passion of inquiry benefit all of us with their studies of the order and structure of the immortal and ageless nature (Euripides fifth century BCE). ■

Note

The information on the near modernity of the Antikythera computer comes from Freeth et al. 2006, 587–591; Freeth et al. 2008, 614–617; and Price 1974, 1–70.

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Evaggelos Vallianatos studied zoology and ancient and medieval Greek history at the University of Illinois, earned a doctorate in Greek-European history from the University of Wisconsin, and did postdoctoral studies in the history of science at Harvard. He worked on Capitol Hill and at the U.S. Environmental Protection Agency. He taught at several universities. He is the author of hundreds of articles and seven books.

Science and Civil Liberties: The Lost ACLU Lecture of Carl Sagan

Around 1987, Sagan gave an uncannily prescient lecture to the Illinois state chapter of the American Civil Liberties Union.

STEVEN PINKER AND HARVEY SILVERGLATE

Credit: Carl Sagan ©1994 by Michael Okoniewsk

The astronomer, science communicator, thinker, writer, and teacher Carl Sagan (1934–1996) had an influence as a scientist that is almost unimaginable today. Together with his many scientific contributions (including his analyses of the origins of life, his discovery of the temperature of Venus and its connection to the greenhouse effect, and his work on nuclear winter), Sagan played a leading role in every NASA spacecraft mission of exploration until his death, designed the first physical messages sent into space, cowrote with Ann Druyan and starred in Cosmos, *a television documentary series watched by half a billion people worldwide, wrote the sci-fi novel* Contact, *which became a major film, and made frequent appearances on* The Tonight Show *and in essays for* Parade *magazine, the weekend supplement to hundreds of American newspapers.*

Around 1987, Sagan gave an uncannily prescient lecture to the Illinois state chapter of the American Civil Liberties Union on the intersection between his area of expertise and theirs. We were fortunate to obtain a recording of that lecture, which we have transcribed, lightly edited, and annotated to update its historical allusions and contemporary relevance. Sagan spoke prophetically of the irrationality that plagued public discourse, the imperative of international cooperation, the dangers posed by advances in technology, and the threats to free speech and democracy in the United States. A thirty-five-year retrospective reveals both increments of progress (some owing to Sagan's own efforts) and continuing menaces.

Most importantly, he highlighted the virtues common to science and civil liberties that are needed to deal with these challenges: freedom of speech, skepticism, constraints on authority, openness to opposing arguments, and an acknowledgment of one's own fallibility.

The two of us, a cognitive scientist and a civil liberties lawyer, are presenting this lecture to the public at a time when Sagan's insights are needed even more urgently than they were when originally expressed. We do so with the kind permission of Ann Druyan, Sagan's widow and longtime collaborator.

—Steven Pinker, Johnstone Family Professor of Psychology, Harvard University, Cambridge, Massachusetts
—Harvey Silverglate, criminal defense and civil liberties lawyer and writer, Cambridge, Massachusetts

Earlier this month I was in Moscow, and in a lovely long dinner, a prominent Soviet intellectual gave a toast. It went something like this: "To the Americans," he said. "They have some freedoms." He paused and then said, "And they know how to keep them."

Is this true? Technology is rushing on apace, and there are propagating consequences of new technologies which put us in directions that are sometimes wholly unexpected.

The first consequence of this is that we must have a broadly diffused understanding of science and technology—otherwise, how will we possibly reach rational adjustments and accommodations to these new technologies? For example, there is a category of technological developments, which are already knocking on the door, which have serious negative consequences and which have solutions that can only be transnational. They therefore have implications about national sovereignty and the ways that nations interact among themselves that are in many respects new.

For example, the chlorofluorocarbons, which threaten the protective ozone layer, are wholly ignorant of national boundaries. They have no idea what supreme national interest means. Chlorofluorocarbon that is generated in the Soviet Union destroys ozone in the United States and vice versa.[1]

The same is true for carbon dioxide and other greenhouse gases produced by the burning of fossil fuels. Those gases are distributed worldwide. It is no good for just a few nations to decide not to burn fossil fuels because of concern about the earth's climate. The entire fossil fuel–burning community of nations must do so for it to be effective.[2]

A leak in a Soviet nuclear reactor threatens the economy and well-being in Lapland—dozens of nations are affected.[3] The same thing is true for many other inadvertent consequences of modern technology: acid rain, for example.[4] It's true also for AIDS because of the fact that the planet is a sexually intercommunicating whole.[5] The only solutions to these sorts of problems are on a global scale.

There are certainly many other obvious civil liberties–technology interactions, ranging from mercury in the drinking water,[6] to how do we guarantee a diversity of views expressed in media which are owned by the very wealthy,[7] to issues of population and birth control,[8] genetic engineering, biotechnology,[9] and so on.

The area which is perhaps most interesting, most perilous, and most significant in this respect is the issue of the global nuclear arms race—the United States and the Soviet Union having rigged the planet with 60,000 nuclear weapons—and tremulously we are exploring a new kind of regime of massive bilateral and intrusively verified arms reduction. That intrusive verification—that onsite inspection—has a very large number of civil liberties questions attached to it, which I believe we will have to deal with if the trend continues, as I hope it will.[10]

Another aspect of this is the clear fact that while the U.S. Constitution specifies that only U.S. Congress can declare a war, the technology of nuclear weapon delivery systems is such that nuclear weapons can be delivered halfway across the planet in twenty minutes or less, and, therefore, Congress cannot even be convened, much less consulted, on urgent issues connected with nuclear war. And this demonstrates—and there are other kinds of demonstrations—that you can design a technology that subverts the Constitution.

And I believe that we will see many other such places where technologies that were wholly unimagined by the Founding Fathers make serious problems for the Constitution. On the issue of technology, I just want to continue for a moment. The incidents at Chernobyl [April 1986] and the catastrophic failure of the space shuttle *Challenger* [January 1986] are reminders that high technology in which enormous amounts of national prestige have been invested can, nevertheless, fail spectacularly. They are, in turn, reminders that pervasive human and machine errors exist—that there is an institutional fallibility even where you would think the best effort had been made to avoid such failures, in areas in which the stakes are extremely high.

The conclusion is that we desperately need error-correcting mechanisms. We are fallible. We're only human. We make mistakes. We have a set of new technologies that, in many cases, we barely know how to control. Those in charge pretend otherwise. The question is: How do we make sure that the most serious sorts of errors do not occur?[11]

Now there is another area of human activity that has to face the same issues, and that's the area called science. Science has devised a set of rules of thinking, of analysis, which, although there are exceptions in individual cases (scientists being humans just like everybody else), nevertheless, on average, are responsible for the remarkable progress of science.

And you all know, certainly, what these rules are. Things like arguments from authority have little weight. Like contentions have to be demonstrable. Like experiments must be repeatable.[12] Like vigorous substantive debate is encouraged and is considered the lifeblood of science. Like serious critical thinking and skepticism addressed to new and even old claims is not just permissible but is encouraged, is desirable, is the lifeblood of science.[13] There is a creative tension between openness to new ideas and rigorous skeptical scrutiny.

This set of habits of thought could also, in principle, contribute to the kind of error-correction mechanism that is desperately needed in the society that we are generating. In public affairs, this sort of error-correction machinery in our society is institutionalized in the Constitution. It's institutionalized, first of all, in the separation of powers, and, secondly, in the civil liberties, especially in the first ten amendments to the Constitution: the Bill of Rights.

The Founding Fathers mistrusted government power, and they had very good reason to, as do we. This is why they tried to institutionalize the separation of powers, the right to think, the right to speak, to be heard, to assemble, to complain to the government about its abuses, to be able to vote or impeach malefactors out of office.

John Stuart Mill talked eloquently in his essay *On Liberty*—which, by the way, is an underground bestseller in the Soviet Union these days, which is another good sign coming out of there[14]—on the importance of free speech, of vigorous interaction. Let me just make one quote here from *On Liberty*:

> The peculiar evil of silencing the expression of an opinion is that it is robbing the human race; posterity as well as the existing generations, those who dissent from the opinion still more than those who hold it. If the opinion is right, they are deprived of the opportunity of exchanging error for truth. If wrong, they lose what is almost as great a benefit: the clearer perception and livelier impression of truth produced by its collision with error.

Despite our best efforts, some things we believe are probably wrong. We certainly are very keen on recognizing the errors of past times and other nations. Why should our nation, why should our time, be different? If there are things that we believe, if there are institutions in our society that are in error, imperfectly conceived or executed, these are potential impediments to our survival. How do we find the errors? How do we correct them?

I maintain: with courage, the scientific method, and the Constitution. Sooner or later, every abuse of power must confront the Constitution. The only question is how much damage has been done in the interim.

Now, it's no good to have such rights if they're not used: a right of free speech when no one challenges the government; a right of assembly when there are no protests; universal suffrage when much less than half the eligible electorate votes; and so on. It is not enough merely to have these rights in principle; we must exercise them in practice. And the Constitution itself is not only a body of knowledge fundamentally about human behavior but also a continuing and adaptive process. In some sense, the U.S. Supreme Court, when it sits, is a continuing Constitutional convention.

Mill said, "If society lets any considerable number of its members grow up as mere children, incapable of being acted on by rational consideration of distant motives, society has itself to blame." And Thomas Jefferson said the same thing in somewhat stronger words. He said, "If a nation expects to be ignorant and free in a state of civilization, it expects what never was and never will be."

Education on the nature of civil liberties, on the need for them, on how to exercise them, is an essential part of the democratic process, and it seems to me almost pointless to have these rights without their exercise. Now, in every nation—certainly in ours; certainly in the Soviet Union—there are a set of forbidden thoughts, which its citizenry and adherents are, at any cost, not to be permitted to think seriously about. (By the way, Mill's book *On Liberty* itself was in that category in many places in many times and was denounced and banned as "dangerous thoughts" by, of all people, the Emperor Hirohito on the eve of the Second World War—one of many indications that it's a good book to read.)

These forbidden thoughts in the Soviet Union—at least until recently—include capitalism, God, and also the surrender of national sovereignty. In the United States, among the forbidden thoughts are socialism, atheism,[15] and also the surrender of national sovereignty—one point of agreement at least.[16]

If we are agreed that there is nothing we can be absolutely sure about, that we have no monopoly on the truth, that there is something to be learned, why is each side so frightened about having the principles of the other expounded? Why, on Soviet television, is there no serious and systematic exposition of the presumptive virtues of free enterprise by someone who holds those views? Why, on American television, is there no consistent exposition of socialism and its purported virtues by people who hold those points of view? What is each side afraid of? What's wrong with a little understanding of what the other side believes? Maybe there is something that can be understood. Maybe there is something that can be used. The fact that both sides are so reluctant to have the philosophy and theology of the other expounded to its people suggests that neither side is fully confident that it has convinced its own people of the truth of its doctrine. And that, of course, is a dangerous circumstance.

Mill argues in such a case that alternative opinions must be heard from persons who actually believe them, who defend them in earnest, who do their very utmost for them. We must know them in their most plausible and persuasive form and not by the propagandists for each side talking to its own citizenry. One goal, it seems to me, of each side ought to be, at the very least, to be able to present the point of view of the other side in a form sufficiently coherent for the other side to say "Yes indeed, that is my position."[17] It seems to me at any summit, the president of the United States ought to be able to make a coherent exposition of what the Soviet point of view is—he doesn't have to agree with it—and the Soviet general secretary should be able to make a coherent exposition of what the American point of view is. How can they negotiate if they don't understand each other's position well enough to state it?

One of the dangers when a democracy is in confrontation with a totalitarian adversary is that the democracy slowly, perhaps unwittingly, becomes more and more like the adversary. Democracies are in danger of losing the very thing that they are ostensibly fighting for—and this is one of many reasons it seems to me why Americans should welcome and support the Gorbachev revolution that is going on—for how long we do not know—in the Soviet Union. If there is any place in the world where an extremely steep gradient, a steep rate of change in the views on the virtues of civil liberties is happening, it's, astonishingly, in the Soviet Union today.[18]

Well, to conclude about this country: during the last decade, it seems to me there has been a terrible backsliding on Constitutional and democratic issues in this country. I don't just mean that the regulatory agencies are, by and large, in the hands of those being regulated. I don't just mean that arms control is in the hands of those who are in favor of the arms race. I don't just mean that social justice is being administered by the ideologues of privilege. I don't just mean that government agencies designed to protect people's rights are in the hands of those who would abolish those agencies. And I don't even just mean that there is what seems to be a conspiracy of high government officials to subvert the Constitution. (I'm referring to Irangate.[19]) It's not just that.

It's also that there has been a serious erosion of the tradition of skeptical inquiry, of vigorous challenging of government leaders, of public exposure of what the government is actually doing, rather than mere pomp and rhetoric. And it is in this area—skeptical scrutiny, public exposure—where the

largest strides, in my opinion, are needed.

Civil libertarians must do more to explain exactly why civil liberties and their vigorous exercise are essential—essential not just to retain what freedoms we have that are, astonishingly, toasted by leading figures in countries we have been taught to think of as our adversaries, but also an exercise in the application of civil liberties that are necessary for our very survival. ■

Notes

1. In September 1987, the Montreal Protocol, designed to protect the ozone layer by phasing out chlorofluorocarbons and related hydrocarbons, was signed by several dozen nations and then ratified by every member of the UN, together with the EU and the Holy See. It has been credited with reversing the process of ozone layer depletion.

2. In 2015, the Paris Agreement, designed to limit global warming to below 2° Celsius above preindustrial levels, was signed and has been ratified by 192 states and the EU. The United States withdrew from the agreement in November 2020 but rejoined it in February 2021.

3. In the wake of the Chernobyl nuclear power plant accident in 1986, The Convention on Early Notification of a Nuclear Accident was adopted. It "established a notification system for nuclear accidents from which a release of radioactive material occurs or is likely to occur and which has resulted or may result in an international transboundary release that could be of radiological safety significance for another State."

4. Many domestic regulations and international treaties aimed to reduce acid rain have been implemented, including the Helsinki Protocol in 1985, the Air Quality Agreement of 1991, and agreements among ten Asian countries beginning in 2000. According to the US Environmental Protection Agency, the American Acid Rain Program "has delivered significant reductions of sulfur dioxide (SO_2) and nitrogen oxides (NOX) emissions from fossil fuel–fired power plants, extensive environmental and human health benefits, and far-lower-than-expected costs."

5. Thanks to the development of antiretroviral drug therapies and programs to promote treatment and prevention globally, including the Joint United Nations Programme on HIV/AIDS and the US President's Emergency Plan for AIDS Relief, the global number of deaths from HIV/AIDs fell by half in the second decade of the twenty-first century, though the disease still kills a million people a year.

6. In 1991, the EPA implemented the Safe Drinking Water Act, setting an enforceable regulation for inorganic mercury in public water systems.

7. In a development Sagan could not have foreseen, concerns in the 1980s about wealthy media companies allowing only a narrow range of opinions to be expressed have been supplemented by concerns over wealthy media companies (particularly cable news networks and social media platforms) fostering political polarization, "filter bubbles," and extremist rabbit holes.

8. Though a runaway population explosion was a major concern of the twentieth century, when the world's population quadrupled, it has recently become apparent that rapid population growth has ended in developed countries, whose populations are set to shrink, and that the population of the world as a whole will stabilize by the century's end. According to the National Center for Health Statistics, in the United States, birth rates in 2020 dropped by 4 percent from 2019 and have been in decline since 2014. In fact, 2020 has had the lowest number of births since 1979.

9. Sagan wrote this well before the announcement of the cloning of Dolly the sheep (1997), the completion of the first draft of the human genome (2000), the widespread use of preimplantation genetic diagnosis (1990s), and invention of the gene-editing technique CRISPR-Cas9 (2012). Concerns about the risks and promises of biotechnology have, accordingly, intensified.

10. It has, at least for now. The estimated number of warheads in the world's nuclear stockpiles has declined from more than 64,000 in 1986 to 9,400 in 2022. Part of the credit goes to Sagan, whose warnings of nuclear winter were cited by Gorbachev in his discussions with the United States on the need for limiting nuclear weapons. The United States and USSR/Russia signed several treaties limiting nuclear arms, but only one, New START, remains in force, and it is set to expire in 2026, leading to concerns about a new nuclear arms race.

11. In this passage, Sagan anticipated by three decades the study of "existential risk," now the focus of several books (such as Toby Ord's 2020 *The Precipice*) and research centers (such as the Centre for the Study of Existential Risk, the Future of Life Institute, and the Global Catastrophic Risk Institute). Though Sagan does not mention it here, his warning about nuclear winter in 1983 was the first systematic and widely publicized analysis of a manmade human extinction event.

12. The replicability of scientific findings emerged as a major issue in the twenty-first century; see Stuart Ritchie's *Science Fictions* (2021).

13. Arguments from authority and the repression of substantive debate and skepticism have become increasingly serious threats to science. See, for example, Jonathan Haidt and Greg Lukianoff's *The Coddling of the American Mind* (2018) and the many assaults on debate in science reported on the website of the Foundation for Individual Rights and Expression (www.thefire.org).

14. Following a period of *glasnost* (openness) and *perestroika* (reorganization) beginning in 1985, when Mikhail Gorbachev came to power, the Union of Soviet Socialist Republics collapsed in December 1991, ushering in a period of limited democracy. It was gradually superseded by the electoral autocracy of Vladimir Putin, particularly at the end of Putin's first term as president in 2008.

15. Since Sagan's time, the taboo against socialism in American politics has been shattered by popular (albeit controversial) politicians who have embraced the once-forbidden label, including Senator (and candidate for the Democratic presidential nomination) Bernie Sanders and Representative Alexandria Ocasio-Cortez.

16. Though Putin's Russian nationalism, culminating in his 2022 invasion of Ukraine, are particularly egregious assertions of national sovereignty in defiance of international law, the United States also has a history of refusing to sign or ratify international treaties, including those establishing the Law of the Sea and the International Criminal Court, and those banning torture, land mines, and cluster munitions. This rejection of international cooperation came to the fore with the rise of Donald Trump's populist nationalism in 2016, which justified his withdrawing the United States from the Paris Climate Agreement. Sagan's observation that "the surrender of national sovereignty" is a "forbidden thought" in both countries remains relevant.

17. The ability to state opponents' positions accurately has recently been highlighted as a cardinal virtue of critical thinking and the new "rationality" movement; see, for example, Julia Galef's 2021 *The Scout Mindset*.

18. See note 15.

19. Also known as Iran-Contra, the secret program that began in 1981 and was exposed in 1986, in which Reagan administration officials facilitated the sale of weapons to Iran, then the target of an arms embargo, with the proceeds directed to aid the anti-communist Contra insurgents in Nicaragua, also illegal at the time.

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Truth, Relativism, and Identity Politics

Since the inquisitions of Galileo and through the present, scientific knowledge has been seen as threatening to political and ecclesiastical authorities. While shared beliefs and group identities provided survival value for our distant ancestors, contemporary identity politics places knowledge in peril.

ROGER A. SABBADINI

Is there such a concept as absolute truth? Most scientists appreciate that there are proven physical principles and laws that could be considered absolutes, even including, paradoxically, the theories of special and general relativity (Capra 2013). Non-physicist relativists argue that there are no absolutes; truth is relative and is subject to more than one opinion on moral or ethical issues, but there is usually little debate on physical or natural principles. To those who hold the objective rationalization view, they argue that, since all opinions are valid, there can be no absolutes—which itself is an absolute statement. It is internally inconsistent to use objective justifications to deny the existence of truths. This conundrum has been termed *epistemic circularity* (Goodman 2009, 1–18). Critics maintain that relativists take the essential skill of critical thinking and extrapolate it to an extreme. A reasonable person can conclude that a critical thinker can accept absolute truths but still question other unverified concepts.

The mechanistic view of the world held by classical physicists and others is that scientific facts, principles, and laws are not opinions, and that this worldview is arrived at by empirical methods of gaining knowledge. According to this view, the concept of an objective reality exists. For example, the Second Law of Thermodynamics (that the entropy of the universe is increasing) and the universal Law of Gravity are not disputed; therefore, acceptance of these laws is not an opinion but instead objective reality. Is the earth flat or round? There are not two opinions on this. There is only one fact, one reality, no compromise. There is no relativism or skepticism on the issue. Rebecca Solnit said it best: "If half of us believe the earth is flat, we do not make peace by settling on it being halfway between round and flat. Those of us who know it's round will not recruit them through compromise" (Solnit 2020).

Realists rely on institutions to validate concepts about objective reality. When faith in those institutions is eroded and delegitimized by conspiracy theorists or adherents to alternative, unscientific belief systems, we lose confidence in the authority of institutions and the "constitution of knowledge."

Thus, the door of opportunity is opened for tyrants or others who claim personal authority to walk in and seize control (Rauch 2021).

So far here we have dealt mainly with scientific truths. However, there are other nonscientific beliefs that some might also characterize as truths that require inspection. In general, beliefs are acceptances that something is regarded as true. Often such judgements are made without proof and are based solely on faith in the source of the information. Conflicts arise when people differ in their trust in those sources. However, reasonable people can find common ground on issues if they agree on a set of facts. Debates over such issues as the economy or immigration may fall into the arena where compromises can be reached. For example, there are differing opinions on what parameters should be used to measure the health of the economy—the Dow Jones Industrial Average, the unemployment rate, the balance of trade deficits, the national debt, etc. Regarding immigration policy, compromises can be reached on quotas and on the issue of granting asylum to those seeking refuge from oppression. Hopefully, facts can be agreed upon and beliefs and opinions shared without challenging the identities or moral judgments of those with whom one negotiates.

The scientific community has witnessed the suppression of scientific ideas and the politicization of science since Galileo, who suffered two inquisitions, in 1616 and 1633, for his scientific observations and writings in the field of astronomy. Galileo's publications supported the Copernican theory that the Sun is the center of the universe, a concept at the time known as *heliocentrism*. Heliocentrism contradicted the conventional model of geocentrism, which held that Earth, rather than the Sun, is stationary and is the center of the universe, promoted since the time of Aristotle and Ptolemy.

This episode was a historic example of identity politics—a form of tribalism where a group's set of beliefs based on their shared identity become politicized. In these cases, it was the shared religious identity of the inquisitors that caused them to consider a heliocentric perspective as an attack on their identity, self-esteem, and cognitive consistency—components of which they referred to as their faith. Individuals inside the group, in this case the Catholic Church, saw those outside the group—scientists such as Galileo—as enemies of the church. The authority and hegemony of the Church gave it license to discriminate against the scientists and heretics whom they considered legitimate targets of their position.

Identity politics have not always been maladaptive. Affiliation with the group has, in many cases, fostered cohesion through shared experiences of race, social status, religion, ethnicity, nationalism, sexual orientation, or gender (Capra 2013, 276–277). Also, the nation is not always equated with the "state." This concept is best explained in Colin Woodard's *American Nations: A History of the Eleven Rival Regional Cultures of North America* (Woodard 2011).

Collective identity often empowered the group for positive change through social activism. The Civil Rights and the Women's Rights movements in the United States are good examples of the politicization of group identity through shared grievances. Shared identity and activism promoted political gains such as the achievement of voting rights in those two movements. Another classic example of identity through shared grievance is that of the Jewish people. Jews have retained a strong ethnic identity through their common historical grievances, beginning with the destruction of the First Temple of Jerusalem (586 BCE) through centuries of pogroms and during the Nazi Holocaust. For many Jews who survived the concentration camps, their suffering was a liberating condition that gave life meaning, but it also gave purpose to their identity group. Auschwitz survivor and psychiatrist Viktor Frankl argued that one could achieve meaning in life by doing a deed, experiencing a value, and by suffering (Frankl 1963). It is not inconsequential that Jews often refer to their ethnic group as MOTs, for "Members of the Tribe," as an expression of their solidarity as a people with a common history and religion, including that of persecution. In November 1947, the United Nations recognized the legitimacy of Jewish grievances by recommending the creation of an independent Jewish state. The State of Israel was created shortly thereafter in 1948. The creation of a separate Arab state, referred to now as the Palestinian State, was also suggested by the United Nations but has not yet come to fruition. The Arab world is similarly united in victimhood because of it.

Shared suffering of a people is not always beneficial. It can also be weaponized as we have seen when the Nazis used their victimhood to create a group identity for the German people in response to their unfair treatment under the Treaty of Versailles. The result was the most destructive war in history and an identity politics–motivated ethnic cleansing.

Identity has both personal and social meanings: sense of self (ego) and affinity for the group, respectively. The two intersect when we perceive that our personal identity and self-image are reflected or shared by others of the larger group. Psychologists call this shared representations. Group identity is cemented by a common set of beliefs, values, and emotions, reinforced by membership in the collective. According to social representation theory, shared explanations of realty are reinforced by social interactions involving the reinforcement of representations—beliefs, ideas, and practices of the group (Rateau et al. 2012; Monroe et al. 2020). We humans desire to fathom a complex world—to establish coherence and stability at times when presented with confusing or conflicting information. Such was the conflict between the biblical faith-based view of the universe and the Copernican fact-based one examined earlier in this essay.

Social interaction through membership or adherence to the shared values of the larger group reinforces a set of representations and can enable a distorted view of those who might harbor different beliefs and worldviews. Often the more extreme and false the message is, the wider it spreads. The larger and more authoritative the group, such as a world religion or nation, the greater the adherence of the individual to that belief structure. Beliefs are fostered by the strength of numbers and the confirmation bias that the numbers reinforce. This is manifested in the current use of social media groups, where disinformation spreads quickly and widely regardless of its

lack of a factual basis but motivated by the need to adhere to the views of the larger identity group. Sharing on social media is the virtual version of political missionary work. On a psychological level, this motivation may partly explain the reason some religious evangelicals work diligently to promote their numbers through missionary work. However, focusing on the numbers *per se* misses the point. In this context, Thomas Paine (1737–1809) put identity politics in perspective: "It is not in numbers, but in unity that our strength lies."

Missionaries as well as warriors, inquisitors, crusaders, and radical jihadists may also be motivated by the righteousness that they believe justifies their activities. This list comprises different versions of identitarian extremists. For missionaries, the altruistic motivation of spreading the Gospel and saving souls promotes group identity through a sense of righteousness. A nation going to war will engender solidarity of the populace by claiming righteousness of the cause and that God is on our side. The mortal enemy threatens not only the viability of the nation but, importantly, its identity. To paraphrase Paul Simon, nations, like individuals, can be blinded by the light of what they believe is God, truth, and right.

Historically, the societal reinforcement promoting unity took the form of rituals, oaths of allegiance, collective symbols, myths, legends, and even language itself; today, the internet has created social networking as a vehicle to share representations that promote bonding within the group. One current manifestation of social representation is confirmation bias and how the internet and social media reinforces conspiracy theories, confirmation biases, and narrow worldviews that distill and simplify voluminous and complex information into a coherent (but disinformed) representation. Beliefs and opinions, even on issues that are fact-based, are influenced by identity and are independent of a person's intelligence and formal education level. Through identity, truth can become relative, and it can be denied if the facts do not fit the group identity. In the words of Benjamin Franklin, "A man convinced against his will is of the opinion still." The motivation is *that* strong. In supporting group identity, the representations—the collective belief system of the group—becomes nonnegotiable. The scarier the social environment, the greater the desire to accept alternative facts and disinformation in cementing the group's identity.

Science remains under attack, but literature has also become a target as have, tragically, people. The outright censorship of literature and the burning of books continues. Censorship of books has a long-standing tradition that historically coincided with commercial printing and has now extended to modern times in other forms. Today, the use of disinformation is a form of *de facto* censorship where facts are either marginalized or diluted by fake news and conveyed via the internet and social media. We have also learned that social cohesion can come at a price—the justification and legitimization of distasteful behaviors that no longer serve a survival purpose for the tribe but result in the delegitimization of others outside the collective. ■

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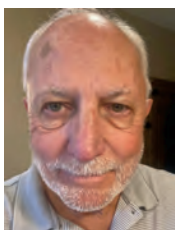

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Nighttime view of the *Queen Mary* at her Long Beach dock (photo by Chris Perley)

There's Something about *Mary* (but It's Not What You've Heard)

The former chief officer of the *Queen Mary* demystifies the tale of an alleged haunting aboard the now-retired ship.

CHRIS PERLEY

The *RMS Queen Mary* was the pride of the British ocean liner company Cunard White Star from 1936 until 1967. She is a niece to the infamous *RMS Titanic*, which sank only eighteen years before the *Mary*'s construction began. The *Mary* was designed to be one of the largest and fastest passenger liners in existence. She was the first to be built exceeding 1,000 linear feet, and she twice held the coveted Blue Riband prize for fastest trans-Atlantic crossing. The ship sailed between Southampton, England, and New York Harbor, with a stop at Cherbourg, France. This is a crossing she made 1,001 times. She played host to dignitaries, heads of state, captains of industry, and Hollywood celebrities. And during World War II, she ferried troops around the world for military service.

Her sailing days are now long behind her. Upon her retirement, the ship was sold to the city of Long Beach, California, for the purposes of becoming a hotel, convention center, museum, and attraction. She left England for her Last Great Cruise on October 31, 1967. This voyage took thirty-nine days, because the ship was eight feet too wide to pass through the Panama Canal. She had to sail around Cape Horn on her way to Long Beach. She arrived at her final home in December 1967 and opened to the public in May 1971. Over fifty million guests have visited the ship. The *Queen Mary* has now been in the waters of California far longer than she was in the North Atlantic.

These days, it isn't just the ship's positive history that people speak of. During her thirty-one years at sea, she carried more than two million passengers, 800,000 soldiers, and 20,000 war brides. Statistically speaking, of course, not all

those passengers completed the voyage safely. There were deaths aboard of passengers and crew members alike. The exact number of fatalities is not known, and in many cases neither are the causes of death. The *Queen Mary* is a vehicle, not a hospital, and autopsies were not performed at sea. If the cause of death was not immediately obvious, the record would simply state "found dead in bunk." Because the ship has had known casualties, it is natural for some to conclude that the ship must therefore be haunted. The ship's operators are now eager to embrace this aspect of her history, running numerous haunted tours, after-hours paranormal investigations, and theatrical seances.

This is where I come in. I have a familial connection to the *Queen Mary*. My mother was a passenger in 1962, and my grandparents traveled aboard in 1937. I began my career on the ship in 2015 as a tour guide and was eventually promoted to ship's officer with an emphasis on the paranormal. I am a vocal skeptic who has never had a paranormal experience (but like any good skeptic, I am open to the possibility, with the proper amount of evidence). My management knew this about me and hoped I could lend a rational voice to the stories being told. And so I did what I do best: research. I wanted to know the truth behind the tales. My main tool was the so-called Book of the Dead, a binder with all the known fatalities as documented in the ship's log entries. I found it very enlightening information.

The deaths on board began before the ship was even named. Construction worker Malcolm Aitken fell from a scaffold at the stern of the ship's hull at the John Brown Shipyard on June 5, 1934, and died. The first ocean-going casualty happened on the return trip of the maiden voyage. Able-bodied seaman Arthur John Francis Golding fractured his skull (presumably while scrubbing the decks) on June 8, 1936, and was buried at sea. The last death during the ship's sailing life was on her final voyage to California. Leonard Horsburgh, a fish cook, suffered a cerebral hemorrhage due to heat stroke. The ship, designed for the cold North Atlantic, had just crossed the equator. Horsburgh succumbed to his injuries off the coast of Rio de Janeiro. The single greatest loss of life involving the ship occurred on October 2, 1942. The *Queen Mary*, acting as a troop transport, was on approach to Northern Ireland with a full complement of soldiers. The threat of submarine attack necessitated a zig-zag pattern by the ship. The *HMS Curacoa*, a light cruiser escorting the *Queen Mary* to port, found itself directly in the path of the much larger liner. The two ships collided, causing the smaller craft to sink. Of the 439 men onboard the *Curacoa*, only 101 survived the collision.

With so much real tragedy surrounding the ship, there is no need to fabricate wild stories about her. I had the opportunity to revise the Haunted Encounters tour script and tried to include as many factual accounts as possible, with a few of our more well-known legends mixed in to keep the tour entertaining. Here are some examples of the prominent casualties.

John Pedder, a young greaser working in the aft engine room in 1966, was tragically crushed to death in watertight door #13. The circumstances around this event remain unknown. Any claims to know details are purely conjecture, because no witnesses came forward. In September 1949, Senior Second Officer William Eric Stark accidentally consumed carbon tetrachloride, which was stored in an old gin bottle. However, he did not pass away on the ship but in a Southampton hospital days after arrival.

As for the ship's legends, they are stories that are told officially by the ship that don't have documentation in the logbooks. Ghost hunters claim that the spirit of a little girl haunts the First Class swimming pool. She is said to be heard singing children's songs or playing hide-and-seek in the pool's changing rooms. The claim is that she died in the Second Class pool and "upgraded" herself to First Class. However, there were no deaths recorded in either of the two pools. The

Photo by Fernando Huerta. Edited by Chris Perley.

Current location of room B474 (in red). There was no room B474 during the ship's sailing career. All room numbers were changed during the ship's 1967–1971 conversion to a dockside hotel. (Photo by Chris Perley.)

worst documented injury I could find was in August 1951 when Mary Walling Ford dove into the First Class pool and hit her nose and lip on the bottom. The story of the little girl has nevertheless become part of the ship's lore and remains one of the most popular accounts.

There were many stories in the Book of the Dead I had never heard before. Among the reports of heart attacks and strokes, I found one page that especially intrigued me: a handwritten copy of a newspaper article. Two names in the article stood out: Dana and Penny. They sounded vaguely familiar. I had heard other guides and guests say the names on rare occasions as a pair of young spirits. A search of the old haunted tour scripts yielded nothing. I then randomly found the answer in one of the books sold onboard:

> According to the late [paranormal investigator] Peter James, two sisters were murdered by their father in room B474 sometime in 1959. The father was distraught for an unknown reason and murdered his wife and two daughters and then killed himself. Dana, four; Penny, two; and their mother were found in bed, strangled by a ligature, and the father was found in the bathroom, victim of a self-inflicted gunshot wound. The girls have been seen and heard in the room on B deck and in the surrounding corridors, oftentimes playing with each other. Dana has been spotted in the cargo hold area and has been heard playing in and around the Archives section in the forward areas of the ship. Both girls have been heard calling out to their mother, so it is assumed that she has passed on while her children have remained behind. Odd as it may seem, these two little girls have been reported in the Green Room area of the ship and have been caught playing in the boiler rooms as well. Other favorite haunts of theirs are the former second-class pool area and the Royal Theater. (Clune and Davis 2014, 79)

The Progress-Index

Serving The Growing Southside Virginia Area

Thursday, July 23, 1964

Husband Kills Family Then Hangs Himself

ROANOKE (AP) — A young salesman described by his neighbors as highly depressed strangled his British-born wife and two young daughters yesterday and hanged himself.

"He never discussed any of his problems but he has been despondent since he moved here three months ago," said Mrs. Jane Tingler Wertz, sister of Frazier Leon Tingler.

The bodies of Tingler, 28, his wife Jill, 25, and their two daughters, Dana, 6, and Penny Lee, 4, were found about 5 p.m. yesterday by their landlord and a plumber who went to the home to repair a sink drain.

The bodies of the wife and children were lying face down in the same bedroom. Tingler's body was hanging by an electric cord from the bedroom door.

Efforts were made to notify Mrs. Tingler's mother, Mrs. J. R. (Mary) Johnston, who sailed yesterday from New York City to return to her home in Surry, England, after a six-weeks visit with the Tinglers.

When it was learned the ship had already sailed authorities decided not to notify her of the tragedy until the ship reaches port.

Tingler, a native of Roanoke, had stayed in England after being discharged from the U. S. Air Force there. He and his family moved to the U.S. about a year ago.

Mrs. Tingler had visited two neighbors shortly before the time police believe the tragedy took place — about 3 or 4 p.m.

"She used to come to see me a lot," said Mrs. Wertz, who told police Mrs. Tingler visited her shortly after Tingler arrived home for lunch. Tingler sold sewing machines and automobile club memberships.

"Being from England she had trouble adjusting here," Mrs. Wertz said. "She didn't know many people. That's why they moved near me."

Another neighbor, Mrs. Joyce Garrett, said Mrs. Tingler spent the morning visiting with her. "She was real happy," she said, adding that she did not know of any family difficulties.

A newspaper carrier said he went to the Tingler home about 3 p.m. to collect and was told by Tingler to come back some other time.

Newspaper article showing that Tingler killed his family and himself at their home in Roanoke, Virginia, not on board the *Queen Mary* (original source: https://www.newspapers.com/clip/2047885/frazier-leon-tingler-family-deaths/)

Some things about the story didn't make sense. For starters, there was no room numbered B474 during the ship's career. The room that currently holds this number was originally two Second Class cabins: B162 and B164. During the ship's 1967–1971 conversion, walls were knocked out in some of the smaller cabins to make larger, more hotel-appropriate spaces. It was at this time that all existing room numbers changed to their current designations. It is unclear from James's telling of this account in which of the two rooms he believed this story to have occurred. Also, an event of this magnitude surely would have been recorded in the ship's logs. Using the information contained in the handwritten article, I was able to track down the full story.

Here are the details that Peter James got right. Frazier Leon Tingler, twenty-eight, did indeed strangle his wife, Jill Johnston Tingler, twenty-five, and their two daughters, Dana, six, and Penny Lee, four, before taking his own life.

However, there is one major problem with James's story: it didn't happen on the *Queen Mary*.

On July 22, 1964, Tingler hanged himself with an extension cord after taking the lives of his wife and daughters, but the murder/suicide happened at the family's home in Roanoke, Virginia. Tingler was suffering from acute depression as well as financial problems. His employer had filed a larceny charge against him earlier that day. Tingler had a note in his shirt pocket attempting to justify his actions.

What does any of this have to do with the *Queen Mary*? I did find some entries in the ship's log that answer this question. Jill's mother, who had been visiting the family from England, boarded the liner that morning for her return trip home. Once at sea, the ship received news of the event by telegraph.

07/23/64 1949 Fr: Cunard Line London

P/L Have been advised that son in law, daughter and 2 grandchildren of Mrs. Florence Mary Johnston T/C passenger have all been killed in USA. Please do everything prevent news reaching her. Other daughter will meet her on arrival. If information has already reached her please instruct Doctor look after her as nervous disposition. Let us know position.

Unfortunately, she had already received the news from Frazier's brother, Loyd (the logs mistakenly identify him as Roy).

07/23/64 0940 To: Cunard/White Star NY

Voyage 437 East — Decode: Mrs. F.M. Johnston T/C C-15 has received information by radio telephone from Mr. Roy Tingler of

The *Queen Mary* under dramatic storm clouds (photo by Chris Perley)

> Salem, Virginia, that his brother has killed her daughter and her two grandchildren and killed himself. Request confirmation

That entry lists Mrs. Johnston's cabin as T/C C-15. That is Third (or Tourist, as it was then known) Class cabin C15. This was two decks down and nearly the entire length of the ship away from the location of B474.

Peter James did make the claim that the two little girls can be heard playing all around the ship, which is rather vague. The location of C15 is now part of the forward Archive section mentioned by James, so the story could be told that they are calling out for their grandmother instead of their mother—but that's not an assertion any of the ghost hunters have made.

Some investigators claim that they have recorded audio of a disembodied argument taking place in B474, saying it is residual "energy" of the tragic event. What is not said is how sound travels on the ship. The walls are very thin to save on material weight. In the sailing days, the engines would create white noise, affording some privacy. Now, without the constant hum of the engines, conversations can very easily be heard from room to room and occasionally from deck to deck. The claimants make no effort to locate the source of the disturbance.

Peter James conducted investigations aboard the ship from the early 1990s until his death in 2007. He most likely had access to the ship's archives and logs. One could argue that he learned of this story and reconfigured the details to be more beneficial to his narrative. Is this accurate? Why did he choose B474 to begin with? There is no way of knowing for sure. But all investigations of B474 since James's initial telling have begun with the premise that his account of the story is true. None have attempted to verify his findings. Had they done so, they would have discovered very quickly that the account didn't occur as James claimed.

I cannot in good conscience let this stand. These are real people who died tragic deaths, and their stories deserve to be told accurately. ■

Chris Perley is a tour guide, photographer, and historian. He served as tour guide and chief officer on the *Queen Mary* starting in 2015. He credits Carl Sagan's *Cosmos* series with inspiring his love of science and nature. He currently lives in New Orleans with his wife, Christy, and their three cats, Gozer, Zuul, and Vinz Clortho.

Dinosaur Bones and Radiocar-bunkum

Recent anti-evolution propaganda claims that radiocarbon in dinosaur bones shows that the bones are mere thousands of years old. However, the bones are millions of years old. They only seem to be younger because fossil bone accumulates new radiocarbon, which produces falsely young radiocarbon readings.

PHILIP J. SENTER

Abundant physical evidence firmly establishes that the earth is billions of years old (Strachan et al. 2020) and that all organisms on earth evolved from a common ancestor (e.g., Prothero 2017). Nevertheless, the young-earth creationist (YEC) movement aggressively promotes the view that God created the earth about 6,000 years ago and that he independently created each kind of organism during the same week (see, for example, websites such as answersingenesis.org, creationresearch.org, icr.org, and genesispark.com).

The YEC crowd has a lot to say about dinosaurs. Most of its dinosaur literature is a bizarre carnival of transparently unrealistic claims. Some of the more entertaining such claims have been addressed and rebutted within the pages of this magazine, including the notions that tyrannosaurs ate melons (Senter 2012) and had mammary glands (Senter 2018), and that dinosaurs breathed fire (Senter 2017a) and were still roaming Europe during the Renaissance, during which their recently killed corpses were publicly displayed (Senter 2019).

While much of YEC dinosaur pseudoscience is similarly difficult to take seriously, some of it bears a deceptive resemblance to actual science. Just as pyrite (fool's gold) sufficiently resembles real gold to fool the untrained eye, this batch of YEC dinosaur pseudoscience is beguilingly slick and warrants careful attention. Among its nuggets of intellectual pyrite are YEC studies on radiocarbon in dinosaur bones. As YEC authors are quick to remind readers, radiocarbon has such a short half-life that no measurable amount of it remains in a specimen after a million years, much less after the sixty-six-million-year span that the youngest Mesozoic dinosaur fossils have lain in the ground (as we know from radiometric dating with isotopes of other elements; see Kuiper et al. 2008; Renne et al. 2013). So when YEC teams subjected Mesozoic dinosaur bones to radiocarbon dating and the bones yielded radiocarbon "dates" between 9,000 and 42,000 years (Dahmer et al. 1990; Fields et al. 1990; Helfinstine and Roth 2007; Thomas and Nelson 2015; Miller et al. 2019), it made heads turn. Granted, those "dates" are still far older than the 6,000 years that the world has existed in the YEC view, but "dates"

of thousands instead of millions of years superficially appear to accord better with the YEC view than that of mainstream science.

I say "superficially" and put the word *dates* in quotes because the YEC teams bungled their radiocarbon studies so badly that their results are meaningless. That revelation has not been very well publicized, and it's high time to do so.

Radiocarbon Basics and the Composition of Bone

Radiocarbon (carbon-14, also written as ^{14}C) is a radioactive isotope of carbon. Cosmic rays continuously generate new radiocarbon in the atmosphere by knocking neutrons off atoms in atmospheric gases. Much of that radiocarbon becomes incorporated into atmospheric carbon dioxide (CO_2). During respiration, plants and algae take in radiocarbon from atmospheric carbon dioxide. Animals take in radiocarbon by eating plants or by eating other animals that have eaten plants. When an organism dies, it stops respiring and eating and therefore stops taking in new radiocarbon. The amount of radiocarbon in its body then drops as the radiocarbon decays into nitrogen without the loss being balanced by incoming radiocarbon. The decay of radiocarbon into nitrogen occurs at a known rate. One can therefore date the organism's death by measuring the amount of radiocarbon in its remains (Walker 2005). This means that if one has an ancient piece of cotton cloth or sheepskin parchment, one can use radiocarbon to date the harvesting of the cotton plant whose fibers were incorporated into the cloth and/or to date the death of the sheep whose skin was used to make the parchment.

Bone tissue includes a mineral fraction and an organic fraction, both of which contain carbon. A mineral consists of an array of positive ions and negative ions that are geometrically arranged such that they form crystals. In the mineral fraction of bone, the positive ions are calcium ions (Ca^{2+}), and the negative ions are phosphate (PO_4^{3-}), hydroxide (OH^-), and carbonate (CO_3^{2-}) ions. The various names for this mineral include *bioapatite*, *carbonated hydroxyapatite*, *dahllite*, and the nicely descriptive moniker *bone mineral* (Senter 2020). The organic fraction of bone consists of blood vessels, nerves, sheets of the protein collagen (around arrays of crystals of bone mineral), and osteocytes (the cells that secrete the collagen and the bone mineral) (Senter 2020). All organic molecules contain carbon atoms, and the carbonate ions in bone mineral also contain carbon atoms. Because both the organic fraction and the mineral fraction of bone contain carbon, either of the two fractions can be subjected to radiocarbon dating.

Radiocarbon has a short half-life, so after a few tens of thousands of years, there is too little of it left to be measurable. As a result, radiocarbon dating has an upper limit of about 55,000 years (Reimer et al. 2020). For remains near to or older than the upper limit of radiocarbon dating, radiocarbon dating yields a date of "greater than *x*," e.g., "greater than 50,000 years" or "greater than 45,000 years," etc., (e.g., Marom et al. 2013; Devièse et al. 2017, 2018; Spindler et al. 2021)—in other words, too old to date with radiocarbon. So when YEC teams subjected Mesozoic dinosaur bone to radiocarbon dating and found dates between 9,000 and 42,000 years (instead of "greater than *x*" dates), it generated much excitement in YEC circles. How could these dinosaur bones be millions of years old when their radiocarbon "dates" were only in the thousands of years? Shouldn't their radiocarbon have been so depleted after millions of years that radiocarbon dating would yield "greater than *x*" dates?

The YEC literature is correct in stating that bones that are millions of years old have indeed lost all their original radiocarbon. But they have since accumulated *new* radiocarbon, which yields a falsely young radiocarbon "date." To understand how that happens, let's review the basics of radiocarbon contamination.

How Contamination Affects Radiocarbon Dating

After an organism's death, the amount of radiocarbon in its remains steadily drops. The older the remains, the less radiocarbon they retain. However, old remains can become contaminated with new radiocarbon, causing radiocarbon dating to yield a falsely young radiocarbon "date." If the remains have been buried, new radiocarbon can be introduced by bacteria, fungi, soil, and encrustation by carbonate minerals carried in groundwater. Such contamination is usually too small to significantly affect the dating of remains that are younger than about 10,000 years. But the older a sample is, the greater the ratio of new radiocarbon (from contaminants) to old radiocarbon (the sample's remaining original radiocarbon). Because of this, the influence of contamination on radiocarbon dating increases with the age of the sample. In samples older than about 10,000 years, the effect is pronounced. It becomes more pronounced with each passing millennium, as the sample's original radiocarbon dwindles while contaminants continuously add new radiocarbon (Zazzo 2014; Wood 2015). This means that although contamination is often not much of a problem for samples of historical age, it is a serious problem for fossil remains.

If only 1 percent of a sample's radiocarbon is new, that small level of contamination is enough for a 50,000-year-old sample to yield a falsely young radiocarbon "date" of 35,000 years. If 5 percent of the same sample's radiocarbon is new, it will yield a falsely young radiocarbon "date" of 24,000 years (Wood 2015). If one makes a graph of a sample's real age versus its radiocarbon "date" for different levels of contamination, one sees that regardless of the level of contamination, the curve flattens at or shortly after about 50,000 years of real age (Wood 2015). This means that a sample with 1 percent contamination will yield a falsely young radiocarbon "date" of about 35,000 years, whether the sample is 50,000 years old, 500,000 years old, five million years old, or 500 million years old. Likewise, a sample with 5 percent contamination will yield a falsely young radiocarbon "date" of about 24,000 years, whether the sample is 50,000 years old, 500,000 years old, five million years old, or 500 million years old.

It is therefore very important to decontaminate a sample that is over 10,000 years old. Fortunately, effective decontamination techniques exist for radiocarbon dating. Unfortunately,

they do not work on bone. As we shall see, that is because bone behaves differently from other materials where radiocarbon is concerned.

Problems with Radiocarbon Dating of Bone: The Mineral Fraction

When a buried bone interacts with groundwater, the chemical composition of its mineral fraction changes as ions in the groundwater replace the ions in the mineral's crystal structure. Such ion exchange is called recrystallization. In the case of bone mineral, recrystallization adds new radiocarbon via carbonate. Carbonate in groundwater is derived from dissolved atmospheric carbon dioxide and therefore contains new radiocarbon from atmospheric carbon dioxide (Zazzo 2014). As carbonate ions in groundwater replace the phosphate and hydroxide ions in buried bone mineral, this incoming carbonate adds new radiocarbon to the crystal structure of the bone mineral. Once recrystallization has incorporated the incoming carbonate with its new radiocarbon into the bone mineral's crystal structure, no decontamination technique can remove it. The bone mineral is thus stuck with its contamination.

Bone mineral that is younger than about 5,000 years can yield an accurate radiocarbon date because it has not yet undergone much recrystallization. But the older a bone gets, the more recrystallization it undergoes, and fossil bone mineral consistently yields falsely young radiocarbon "dates" that get further and further from the bone's real age with every passing millennium (Zazzo and Saliège 2011; Zazzo 2014).

Bone mineral is protected from recrystallization if it is cremated, because the extreme heat alters the mineral's crystal structure in such a way as to prevent recrystallization (Olsen et al. 2013). Bone mineral is also protected from recrystallization if it is in an arid environment without groundwater or rainwater, which create the aqueous medium in which post-burial recrystallization occurs. But Mesozoic fossil bone has not been cremated, and it has lain in the ground too long to have avoided water. No place on earth has been arid long enough to have prevented recrystallization in Mesozoic dinosaur bone—not even within the short 6,000-year time frame of the YEC paradigm. Even the large swath of Africa that is now covered by the Sahara Desert was very rainy as little as 5,000 years ago (Tierney et al. 2017). Besides, according to the YEC view, most Mesozoic dinosaur fossils were buried by the Genesis Flood, which means that even in the YEC view, they have been subjected to an aqueous environment that encourages recrystallization.

Recrystallization of bone mineral explains how YEC teams (Dahmer et al. 1990; Fields et al. 1990; Helfinstine and Roth 2007; Thomas and Nelson 2015) have found radiocarbon "dates" of less than 50,000 years for Mesozoic dinosaur bones. The YEC authors are correct in stating that the bones' original radiocarbon should be depleted if the bones are millions of years old, and indeed, it has been depleted. But through recrystallization, the bones have since accumulated new radiocarbon and therefore yield falsely young radiocarbon "dates." Contamination prevents those false "dates" from exceeding 50,000 years, even for bones that are millions of years old.

Problems with Radiocarbon Dating of Bone: The Organic Fraction

The recrystallization problem applies only to the mineral fraction of bone, not to the organic fraction. So if one separates the two fractions and subjects only the organic fraction to radiocarbon dating, one can circumvent the recrystallization problem. Unfortunately, one must still deal with the collagen problem.

The organic fraction of bone is often called the "collagen fraction," because after the cells have decayed away, most of what's left is the sheets of extracellular collagen around the crystals of bone mineral. Unfortunately, the collagen in buried bone tends to get contaminated by materials in the soil that introduce new radiocarbon. Fortunately, a decontamination technique called ABA (acid-base-acid) can be used to combat that problem. Unfortunately, ABA is not sufficient to decontaminate fossil bone collagen. That is because over time, bone collagen forms molecular bonds called *cross-links* with neighboring molecules from the humus and sediment that surround it (van Klinken and Hedges 1995). Once a cross-link is formed, no decontamination technique can separate the collagen from the contaminants. Decontamination techniques such as ultrafiltration and ABOx-SC (acid base oxidation–stepped combustion) are stronger than ABA, but even they can't remove the cross-linked contaminants. As a result, the so-called "collagen fraction" in fossil bones consistently yields a falsely young radiocarbon "date" (Higham et al. 2009; Higham 2011; Marom et al. 2012; Marom et al. 2013; Devièse et al. 2017; Devièse et al. 2018; Spindler et al. 2021).

Another problem for the organic fraction of fossil bone is glue. Fossil bone is fragile. To keep it intact during the excavation process, excavators pour glue onto it and allow the glue to soak into the bone before continuing. It is a painstakingly slow process: expose a small amount of bony surface, pour the glue, wait for it to soak in, then repeat. As a result, it may take years to fully free a huge fossil skeleton from the sediment that entombs it. Meanwhile, the organic fraction of the fossil bone gets more and more contaminated by the glue. A significant percentage of the so-called "collagen fraction" of a fossil bone is therefore largely glue, which introduces new radiocarbon that contributes to a falsely young radiocarbon "date" (Nalawade-Chavan et al. 2014).

The only way around the problems of cross-linked contaminants and glue is to separate a collagen-specific part of the so-called "collagen fraction" from the rest of the organic material and subject only that collagen-specific part to radiocarbon dating. Fortunately, such a technique exists. Collagen is a protein, and proteins are made of smaller units called amino acids. The amino acid hydroxyproline (abbreviated HYP) is abundant in collagen and not much else. So if one extracts only the HYP and subjects only it to radiocarbon dating (a technique called the HYP method), one can get an accurate radiocarbon date for the fossil bone (Marom et al. 2012; Marom et al. 2013; Nalawade-Chavan et al. 2014; Devièse et al. 2017; Devièse et al. 2018; Spindler et al. 2021). This, of course, will only work if the glue is not collagen-based. Another complication is that the bone must be younger than

the upper limit for radiocarbon dating. For fossil bone older than that, the HYP method will yield a date of "greater than *x*," e.g., "greater than 43,000 years" or "greater than 45,000 years," etc. (Devièse et al. 2018; Spindler et al. 2021).

In 2019, a YEC team finally reported a set of radiocarbon "dates" for Mesozoic dinosaur bones in which they used only the "collagen fraction" without the mineral fraction (Miller et al. 2019). They thus avoided the problem of contamination via recrystallization of bone mineral. The team used ABA to decontaminate the "collagen fraction." However, all the "dates" that they obtained were over 10,000 years. As we have seen, bone that is older than 10,000 years cannot yield an accurate radiocarbon date except via the HYP method. The team did not use the HYP method, and therefore their radiocarbon dates for the dinosaur bones are falsely young.

To make a long story short, multiple YEC teams have now subjected Mesozoic dinosaur bone to radiocarbon dating, and each YEC team has botched the procedure so badly that all their radiocarbon "dates" are wrong—very, very wrong. Radiocarbon dating only works when you do it right. So far, no YEC team working with Mesozoic dinosaur fossils has done it right.

YEC Rebuttals That Fail

In 2020, *The American Biology Teacher* published an article of mine (Senter 2020) in which I explained the problems with the mineral fraction of bone for radiocarbon dating. In the article, I showed how the recrystallization problem falsifies YEC radiocarbon "dates" for Mesozoic dinosaur bone samples that include bone mineral. In response, YEC blogger Jay L. Wile posted a lengthy attempt at a rebuttal to my article (Wile 2021). Its points are worth addressing, because future YEC writers are likely to repeat them. To the untrained eye, it appears to be a successful rebuttal, but the eyes of readers of Skeptical Inquirer who continue to the end of the present article will be trained and therefore not so easily fooled.

Wile's first point: In my 2020 article, I stated that "bone mineral is usually useless for radiocarbon dating." According to Wile, that is a false statement, because hundreds of studies have done radiocarbon dating of bone mineral.

The facts: Wile does have a point in this case. Bone mineral that is younger than about 5,000 years often yields a correct radiocarbon date. However, the same is not the case for *fossil* bone, in which recrystallization is a serious problem for radiocarbon dating. So I should have worded my offending sentence better, thusly: "*Fossil* bone mineral (i.e., bone mineral older than 10,000 years old) is usually useless for radiocarbon dating."

Wile's second point: According to Wile, Holocene and late Pleistocene bone mineral yields correct radiocarbon dates.

The facts: The Holocene Epoch is the present one. It began approximately 11,700 years ago (Walker et al. 2009). The Pleistocene Epoch, which preceded it, began approximately 2.6 million years ago (Gibbard and Head 2020). Contrary to Wile's statement, late Pleistocene and early Holocene bone mineral usually yields falsely young radiocarbon dates (Zazzo and Saliège 2011; Zazzo 2014). Wile's reference for his statement is Cherkinsky (2009), but there are problems with that reference, as follows. Cherkinsky's paper is on a technique for removing surface encrustation (carbonate crust on bone), to get rid of the influence of new radiocarbon in encrusting carbonates. In that paper, Cherkinsky admits that the technique cannot remove new radiocarbon in new carbonate that had arrived via recrystallization. Cherkinsky thought his technique could get bone mineral to yield a correct radiocarbon age, because it got the mineral fraction to yield a similar date as the so-called "collagen fraction" in Holocene and late Pleistocene bone samples, and he expected the "collagen fraction's" radiocarbon date to be correct. But the "collagen fraction's" radiocarbon date isn't correct. As mentioned above, the so-called "collagen" fraction is actually collagen *plus* organic contaminants (Nalawade-Chavan et al. 2014; Spindler et al. 2021), and the new radiocarbon in those contaminants significantly throws off a radiocarbon date even in samples as young as the late Pleistocene and early Holocene (Marom et al. 2012; Marom et al. 2013; Devièse et al. 2018).

Wile's third point: According to Wile, the Zazzo (2014)

reference does not support the statement that radiocarbon dating of bone mineral yields an incorrect age.

The facts: Zazzo (2014) shows that the radiocarbon "date" of bone mineral is consistently younger than that of the collagen fraction from the same bone. Thus, Zazzo (2014) *does* show that the mineral fraction yields a falsely young age.

Wile's fourth point: According to Wile, many dinosaur fossils have been radiocarbon dated with both the mineral and collagen fractions, and the ages are similar.

The facts: The reference that Wile cites (Miller et al. 2019) is currently the only study in which the "collagen fraction" of dinosaur bone has been separated from the mineral fraction and subjected to radiocarbon dating. The dates are consistently between 22,000 and 42,000 years (which, of course, contradicts the YEC view that the world is only 6,000 years old). As we have seen, (1) the so-called "collagen" fraction includes not only collagen but also all the non-collagen organic material that is cross-linked to it, (2) the HYP technique is necessary to circumvent that problem in fossil bone, and (3) Miller et al. (2019) did not use the HYP technique. The radiocarbon "dates" of the dinosaur bone "collagen" that Wile cites are therefore falsely young.

Wile's fifth point: According to Wile, if a bone is contaminated, there should be more contamination near the surface (yielding a younger radiocarbon "date") and less in the protected interior (yielding an older radiocarbon "date"), yet the numbers in figure 7 of Miller et al. (2019) do not show such a pattern.

The facts: As I have personally observed through many years as a paleontologist, fossil bone is usually cracked in so many spots, so deeply, that a lot of the interior is as vulnerable to contamination as the exterior.

Wile's sixth point: In my 2020 article, I mentioned that uranium decay adds more radiocarbon to uranium-rich fossil bones, because radiocarbon is produced by the radioactive decay both of uranium and of some of its radioactive daughter isotopes. Dinosaur bone mineral in uranium-rich deposits incorporates uranium (which replaces the calcium) into its crystal structure via recrystallization, and the bone mineral gains new radiocarbon as the uranium decays. According to Wile, the incoming radiocarbon from that source is negligible, because nuclear reactions from uranium decay can only account for 1/100th of the lowest amount of radiocarbon found in dinosaur bone. To support that statement, Wile cites Bonvicini et al. (2003).

The facts: The Bonvicini et al. (2003) reference is on oilfield rocks, not fossil bone. Fossil bone concentrates uranium with great enthusiasm, and uranium concentrations can be one or more orders of magnitude higher in fossil bone than in oilfield rocks. As a result, the production of radiocarbon by uranium in the bone is expected to be orders of magnitude higher than it is in oilfield rocks. Bonvicini et al. (2003) list the uranium concentration in oilfield rock as 0.45 ppm in oilfield sandstone, 2.2 ppm in oilfield limestone, and 3.5 ppm in oilfield shale (Table 2 of Bonvicini et al. 2003). In contrast, the uranium concentration in uranium-enriched fossil bone is listed elsewhere as 100 ppm in a bone of the Jurassic dinosaur *Dilophosaurus*, 30 ppm in another *Dilophosaurus* bone (Table 1 of Goodwin et al. 2007), 50 ± 20 ppm in a bone of the Paleozoic (before the dinosaurs) reptile *Deltavjatia*, and 21 ± 8 in another *Deltavjatia* bone (Table 1 of Kiseleva et al. 2019). Similarly high or higher concentrations of uranium can be present in uranium-enriched fossil shells (up to 18 ppm; Table 1 of Ayling et al. 2017), petrified wood (up to 90 ppm; p. 272 of Jiang et al. 2018), and coal (up to 178 ppm; Tables 1–6 of Yang et al. 2007; up to over 60,000 ppm; table 1 of Havelcová et al. 2014).

Wile's main point: According to Wile, "in the end, Dr. Senter must use false information to assure his readers … [that radiocarbon dating of fossil bone mineral yields incorrect results]."

The facts: The information in my article came not from me but from my references. Essentially, Wile is calling those dozens of references false information. So he's really arguing not against me but against an army of authors of primary geological literature that passed peer review and used correct scientific procedures to produce correct results.

That is not surprising. When it comes to the dating of fossils, YEC authors do not like correct results, because those results contradict the YEC paradigm. Instead, they prefer the incorrect results that they produce by doing scientific procedures incorrectly. Their bungled radiocarbon studies of Mesozoic dinosaur bone are cases in point, which serve as illustrations of how incorrect procedures produce incorrect results.

Closing Thoughts from a Scientist Who Is a Christian

Wile (2021) describes himself as "a scientist who is a Christian." I, too, am a scientist who is a Christian: a happily practicing member of the Orthodox Church, which is arguably the most conservative of the Christian denominations. A diligent internet search will reveal some old posts in which I am described as an atheist, which was accurate at the time. But that was many years and a heartfelt conversion ago. As someone who has a graduate-level education in both science and theology, I think that it is within the scope of my expertise to say—however much the following wording may be distasteful to some readers of this magazine—that God's revelation through nature (as a scientist who is a Christian might call it) unequivocally reveals that the earth is billions of years old and that the bodies of all organisms evolved over billions of years from that of a single-celled common ancestor. As I have shown elsewhere, the Bible itself teaches the reader not to take Genesis literally (Senter 2016; Senter 2017b; Senter 2022). Said biblical teaching frees a Bible-believer to accept that which a scientist who is a Christian might call God's revelation through nature, a revelation that contradicts a literal Genesis but does not at all contradict the underlying meaning of Genesis as it was meant to be understood (Senter 2022; see also McEvenue 1990; Schlimm 2015; Dever 2020). There is therefore no biblical justification to rescue a literal Genesis by defending botched radiocarbon studies on Mesozoic dinosaur bones. ■

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Pseudoscience Offered by a Young-Earth Creationist

The Cambrian Tapeats Sandstone in the Grand Canyon area of Arizona cannot have been wet and soft when it was locally folded and cannot have originated during the supposed worldwide Noah's flood.

LORENCE G. COLLINS

Andrew Snelling, director of research at the organization Answers in Genesis, wrote a short article in a creationist publication describing his study of fifty-three samples he collected in the Grand Canyon (Snelling 2021a). He gathered them to support his view that two Tapeats Sandstone places and one place each in the Bright Angel and Muav formations were folded soon after all these sedimentary layers were deposited within days or months following Noah's flood. Only the Tapeats Sandstone (see Figure 1) is discussed hereafter. In his article he wrote:

> (a) none of the evidence supports the evolutionary idea that the folding occurred 450 million years after the sandstone was cemented. Instead, it is overwhelmingly consistent with the sand layers being deposited rapidly at the beginning of the global flood cataclysm year. The bending of the still wet, soft layers occurred only months later at the end of the flood year when the plateau was uplifted. The sand layers cemented to sandstone as they dried out at the end of and after the flood. Furthermore, no evidence points to any metamorphic changes in the sandstone or its mineral grains, either in the folds or in the samples miles away from the folds, (b) that his research has convincingly confirmed that Grand Canyon's layers were deposited violently during the yearlong global flood cataclysm only about 4,350 years ago and demonstrates the short time between when the Tapeats was deposited and folded—eliminating the possibility of hundreds of millions of years within the layers, and (c) that he is certain that what he saw in Grand Canyon's outcrops and through the geological microscope confirmed the biblical account.

Snelling says that boulders at the base of the Tapeats Sandstone that covers the Great Unconformity on top of the underlying Precambrian Vishnu Schist and the Zoroaster Granite Complex were transported by rapid hurricane- and/or tsunami-driven water currents. But large boulders are commonly found in the basal portions of river-deposited sandstone layers, and, therefore, such boulders are not necessarily transported by rapid hurricane- and/or tsunami-driven water currents. The boulders there consist of granite, quartzite, conglomerate, and schist. The Vishnu Schist that underlies most of the Tapeats Sandstone in the Grand Canyon is rich in biotite and hornblende, and, therefore, the overlying Tapeats Sandstone should be unusually rich in biotite mica and hornblende if this sandstone is locally derived, but that is not the case. Moreover, the larger masses of granite that intrude the Vishnu Schist in the Zoroaster Complex are biotite granites or biotite-hornblende-bearing granitic rocks, and most are not muscovite-bearing rocks. Only one very small pluton is biotite-muscovite bearing, and a few narrow pegmatite dikes that cut the Vishnu Schist in the area are muscovite-bearing (see Ilg et al. 2003).

Figure 1. A view of the layers of sand in the Cambrian Tapeats Sandstone in Deer Creek, a tributary of the Colorado River in the Grand Canyon of Arizona.

These observations contradict Snelling's opinion that the large amounts of muscovite and K-feldspar in the large volume of the Tapeats Sandstone overlying the Great Unconformity have been locally derived by hurricane- or tsunami-driven currents generated during Noah's flood that eroded the underlying Precambrian rocks. Instead, they must have been transported into the Grand Canyon area during erosion of Precambrian muscovite- and K-feldspar-bearing granitic crustal rocks from a distant source.

Snelling says that the layering, as shown in Figure 1, indicates that the sand was rapidly transported and deposited by the hurricane- or tsunami-driven currents, but such water flows would not sort the grains into nearly uniform grain-size as seen in Figure 1. Supposed tsunami-driven currents of such large force would have deposited a jumbled mixture of boulders and sand grains, and the lack of boulders in most of the layers could just as well result from periodic yearly storms having less power of erosion.

Snelling says that the fossilized tracks in the layers were left behind by trilobites, worms, and other invertebrates that

had scurried across or hurriedly burrowed into sand surfaces. In his model, to be preserved those delicate traces would have had to be buried rapidly. However, although rapid burial is often necessary for animal life to be preserved as fossils, such rapid burial can happen in periodic, yearly, winter storms and has no requirement for the animals to be buried by Noah's supposed rapidly moving flood waters. There is no real basis for Snelling's claim that fossilization requires rapid burial; he makes this claim because it meshes with his belief about a short timescale. Moreover, if Noah's flood waters suddenly rushed upon the trilobites, worms, and other invertebrates, these creatures would not have time to scurry across or burrow into sand surfaces. The hurrying of the animals to escape the flood waters is in the imagination of Snelling, and this hurrying has to apply from top to bottom in this formation. That is not realistic! How would they know in each higher level of the deposits in which they lived that flood waters were coming repeatedly throughout the whole time in which these layers were being deposited?

There is no real basis for Snelling's claim that fossilization requires rapid burial; he makes this claim because it meshes with his belief about a short timescale.

Furthermore, each layer in which fossils of animals are found, the animals there would have been killed by the overlying deposition of sediment. Therefore, animals eventually preserved as fossils at higher levels above a given fossil-bearing layer must have had to start over beginning with new creatures. That is, at the end of the deposition of a layer that buries and kills animals, enough time must exist for new animals to be generated and be alive before they can supposedly scurry around and be buried by the next layer on top of them. Each new generation of animals must take more than a year's time for eggs coming in from outside sources to be fertilized and grow to become adult animals. Therefore, such repeated more-than-one-year growth times of new animal generations in hundreds of layers in a formation that is as much as 330 feet thick in the Grand Canyon area simply cannot have happened during Noah's one-year flood.

Snelling says that many grains of quartz in the Tapeats Sandstone are not very rounded, which in his view is an indication that there was not time for the grains to be completely rounded during their transport. But quartz grains transported in water are rarely ever rounded—even after traveling long distances. The rounding of quartz grains is more often observed in windblown sands (however, not in all desert terrains), not in water-transported sands. Because quartz grains have a hardness of 7 on the Mohs hardness scale and are not easily abraded (and because these grains are mostly carried in suspension in the water), the water acts as a lubricant, pre-

Glossary of Geologic Terms

Detrital particles – small broken fragments of minerals that have been eroded from sedimentary, metamorphic, and/or igneous rocks.
K-feldspar – potassium feldspar.
Pegmatite dike – coarsely crystalline granite with crystals several centimeters long that intrudes the Vishnu Schist in narrow masses.
Pluton – a volumetrically large igneous mass of rock in which its silicate minerals are coarsely crystalline and coarser than those found in volcanic rocks.
Precambrian Vishnu Schist – layers of metamorphosed volcanic and sedimentary rocks that are ~1.75 billion years old and whose total thickness is unknown, but outcrop exposures of 25 km (16 miles) occur in the Grand Canyon.
The Great Unconformity – an angular erosional boundary between rocks of different ages as with those between the younger overlying horizontal sedimentary rocks and the underlying older Vishnu Schist and Zoroaster Granite Complex in the Grand Canyon as observed by John Wesley Powell in 1869.
Zoroaster Granite Complex – localized intrusions of granite masses and dike swarms in the Vishnu Schist that are younger in age than the deposition and metamorphism of the Vishnu Schist.

venting abrasion that would cause rounding.

Snelling points out that the cement binding the grains together to make the Tapeats Sandstone into a hard rock is primarily quartz (silica). But such silica could not have been present in Noah's flood water. In the biblical Noah's flood, the water is said to come from abundant rainfall. On that basis, this water could have been neutral water (pH 7) or slightly acidic water (less than pH 7) because of the carbon dioxide content picked up from the atmosphere or still more acidic water (much less than pH 7 because of the dissolved hydrogen chloride [HCl] or hydrogen sulfide [H_2S] content in volcanic water emerging from mid-ocean spreading centers from the mantle, which could have been the supposed "fountains of the deep"). The important observation is that acidic water does *not* dissolve silica. Therefore, the silica that cemented the Tapeats Sandstone into solid rock must have diffused as ions in water outside of the Tapeats Sandstone, and this water would have been basic (high pH, greater than 7) and likely came from upper younger Paleozoic sedimentary rocks rather than from the Tapeats Sandstone. Such diffusion would have taken a much, much longer time than a few months after Noah's flood ended—probably hundreds of thousands of years.

The Tapeats Sandstone contains clay minerals between the quartz grains and as the dominant component in interlayered clay (shale) layers. These clay minerals are illite, smectite, and kaolinite with illite being dominant (mostly near 70 percent). Illite is created by the alteration of muscovite and K-feldspar weathering, and the Tapeats Sandstone contains both muscovite and K-feldspar. But illite cannot be created quickly in the time frame of 6,000 to 10,000 years (the alleged age of the earth asserted by Snelling). The weathering of granite is exceedingly slow, as is indicated (a) by observations of dated granite tombstones, measured in thousandths of an inch per year; (b) by the slow weathering and erosion time of granite outcrops on the coast of Maine where almost no erosion has occurred during repeated hurricanes in the 200 years that people have lived in houses along the coast of Maine; (c) by the lack of weathering of granite building blocks in Egyptian temples constructed thousands of years ago; and (d) by the lack of weathering of granite in closely fitted building blocks of city houses and temples in ancient Machu Picchu in the Andes Mountains of Peru. It takes millions of years to make illite in the quantity found in the Tapeats Sandstone.

Snelling says that the Tapeats Sandstone must have bent (folded) after the silica cement had set because he found no signs of breakage in the quartz grains or the cement. However, in the Carbon Canyon fold Snelling sampled, the layers were brittle at the time of folding, and they had a lot of fractures and cracks as is shown in Figure 12-13 on page 125 in the Grand Canyon book (Hill et al. 2016). This fracturing is further confirmed in Snelling's thin sections, because the rock samples were impregnated under confining pressure with epoxy resin that contained a blue dye. The blue dye observed in his thin sections show that in many places it is localized at cracks and in some places cuts the silica cement as well as the quartz particles. Such an observation very clearly shows that the Tapeats Sandstone was solid rock at the time of deformation and *not* soft and wet; it's just baffling that Snelling insists otherwise.

Additional scientific evidence exists that the Tapeats Sandstone and other rocks in the Grand Canyon cannot have been produced prior to or during Noah's flood.

Finally, we return to Snelling's belief that the boulders at the base of the Tapeats Sandstone were transported by rapid hurricane- and/or tsunami-driven water currents. It is well known that there are not any horizontal currents in oceanic waters generated by hurricanes or tsunamis that in Snelling's model supposedly transport sedimentary particles short distances (or, for that matter, long distances as the evidence shows) or cause any erosion by such horizontally traveling water. The motions that occur in hurricanes and tsunamis are circular and do not involve horizontal movements of water except when the bottom of a circular wave form reaches a shallow portion of the ocean near a continental shoreline where it drags by friction and slows down while the top of the wave form continues at full speed. This slowing down shortens the wave length and increases the amplitude of the wave to greater heights. At some point, the top of the wave (the crest) moves forward so fast relative to the bottom of the wave that it spills forward as a breaking wave that surfers love to ride. This spilling forward is the only time in which horizontal motion occurs. That is, for most of the wide breadth of the supposed worldwide Noah's flood water, there would have been no moving horizontal currents that could have transported sedimentary particles any distance.

The circular motion of wave forms in water can be generated by wind, such as the powerful winds generated in hurricanes, but the same circular motion can also be created by tsunami-generated waves—except that in tsunamis the diameter of the circle is much larger than in hurricane-generated waves.

Tsunami waves produced by a major earthquake can create spilling waves that can be amplified to great heights, perhaps as much as fifty to 100 feet high, which could do a lot of coastal damage and drown people who live near the shore. That is what happened along the coast of Japan during the 2011 Tohoku tsunami and earthquake (magnitude 9.0 to 9.1) and along the coast of Sumatra during the 2004 Sumatra tsunami and earthquake (magnitude 9.1). Many people in Alaska were also drowned in the 1958 Lituya Bay tsunami and earthquake (magnitude 7.8 to 8.3). However, in all three major earthquakes and tsunami-generated waves, little to no erosion of the rocks occurred in the bordering coasts in any of the three places. But note that in Snelling's model he suggests that huge amounts of erosion occurred during Noah's one-year flood and that the eroded sedimentary particles were deposited violently in the Tapeats Sandstone during the yearlong global flood cataclysm only about 4,350 years ago. Therefore, in his model, supposedly the eroded detrital parti-

Figure 2. Stream cross-bedding in Tapeats Sandstone in Deer Creek. (Source: Google Tapeats Sandstone images; permission granted via Steve Semken.)

cles came from the Precambrian basement rocks, and this erosion created the Great Unconformity and was done quickly by rushing hurricane and tsunami currents.

But the fact that little to no erosion occurred in Japan, Sumatra, and Alaska is convincing evidence that the eroded Precambrian surface at the Great Unconformity cannot have been produced by erosion during the supposed one-year Noah's flood and instead must have taken millions of years.

The spilling forward of the circular motion of waves generated in large storms are known to pick up pebbles and throw them out of the top of the spilling crests, tossing them in the air perhaps 100 feet beyond the shoreline to produce what is called a "storm beach" with deposited piles of pebbles. These tossed pebbles can pound rock cliffs along a continental coast and cause erosion, but it is not rushing water in currents that erodes or transports sedimentary particles as Snelling claims.

The same kind of erosion caused by moving tossed pebbles on coastline cliffs is caused by moving water in stream erosion. It is the pounding of the bedload boulders, rolling and tumbling on the stream valley floor that erodes the rocks in the bottom of a stream channel. Smaller sand particles are mostly carried in suspension above these boulders and never touch the bottom rocks, but some of them there polish smooth the metamorphic and granite rock surfaces with hardly any erosion of the minerals in the bedrock. Streams carrying quartz sand particles can erode softer sedimentary rocks, such as shales, limestones, and sandstones, but not easily erode the Vishnu Schist or the granitic rocks in the Zoroaster Granite Complex.

Therefore, the critical comments in the above paragraphs show that Snelling's model of creating the Tapeats Sandstone in the Grand Canyon area of Arizona by Noah's flood waters has no merit. For the most part, the layers of sandstone in this layered formation are *stream deposited* as revealed by occasional stream cross-bedding (Figure 2) (which would not have been created by hurricanes or tsunamis), or they were produced during other kinds of environmental conditions that are described in the literature published by "evolutionists" that Snelling has reported in another article (Snelling 2021b). Such environmental conditions include the fact that the cross-bedding in most of the Tapeats Sandstone was produced during deposition of fast moving water in braided rivers or streams or in shallow marine settings.

Most certainly, the Tapeats Sandstone did not originate during the supposed worldwide Noah's flood (Collins 2021a; Collins 2021b), and the age of the Tapeats Sandstone must be 563 ± forty-nine million years old on the basis of a fission-track age for twelve zircon grains in a green tuff bed in this formation (Naeser et al. 1989). Additional scientific evidence exists that the Tapeats Sandstone and other rocks in the Grand Canyon cannot have been produced prior to or during Noah's flood (Collins 2018a; Collins 2018b; Collins 2018c). ■

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Lorence G. Collins is a retired professor of geology from California State University Northridge. He has eighty-three articles on the website http://www.csun.edu/~vcgeo005/creation.html, most of which he authored, that describe various views of young-earth creationists and the errors in their interpretations. Among his SI articles are "Twenty-One Reasons Noah's Worldwide Flood Never Happened" (March/April 2018).

THE BENEFITS OF A CHARITABLE BEQUEST

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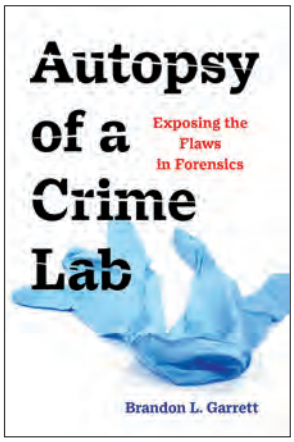
The Flaws in Forensic Science

Terence Hines



Autopsy of a Crime Lab: Exposing the Flaws in Forensics. By Brandon L. Garrett. Oakland, CA: University of California Press, 2021. ISBN 978-0-520-37933-6. 252 pp. Hardcover, $29.95.

The 2009 National Academy of Science report *Strengthening Forensic Science in the United States: A Path Forward* first brought to public attention the serious problems with the forensic sciences. Now, well over ten years later, the state of forensic science in the United States still leaves much to be desired. Brandon L. Garrett, a law professor at Duke University and active investigator of the problems with forensic science, has written an important book examining the current state of forensic science and ways to improve it. It is well written and extensively referenced. In addition to discussing the data on various discredited forensic techniques—which, sadly, are often still used—the book describes specific cases where such techniques have led to innocent individuals being imprisoned for lengthy periods or even executed.

He divides the book into four sections: The Crisis in Forensics (two chapters), Flawed Forensics (six chapters), Failed Labs (two chapters), and The Movement to Fix Forensics (three chapters). The first section is a brief review of forensic techniques with the first chapter focusing on bite-mark analysis as a case study of an unreliable and invalid forensic technique. *Reliable* in technical terminology means that a procedure gives close to the same results on repeated testing. *Valid* means that it measures what it claims to measure. Bite-mark analysis is far from the only questionable technique still used in criminal investigations and trials.

It's one thing to criticize techniques, but what criteria would a technique meet that could be fairly used in court? This issue was addressed directly in the 1993 U.S. Supreme Court case of *Daubert v. Merrell Dow Pharmaceuticals* (509 U.S. 579), in which the Court spelled out five criteria that must be met by any method before its results can be admitted as evidence: 1) The method has to be testable to see if it provides accurate information; 2) It must have been subjected to peer review; 3) The error rate of the method must be known; 4) Standards such as accreditation of experts in the field must exist; and 5) The technique must be accepted by the scientific community.

The crisis in forensics is that almost none of the commonly used forensic techniques—including bite-mark, blood-spatter, and firearms analysis; tool-mark identification; alcohol breathalyzer tests; and even fingerprint identification—are very accurate. They have only rarely been subjected to objective studies, and when this has been done, the techniques are found to have low reliability and thus don't meet the *Daubert* standards. The problems with specific techniques are discussed in the second section. It includes descriptions of cases in which overconfident (or downright incompetent or dishonest) forensic technicians have provided false evidence.

It will surprise many that the use of fingerprints for identification—probably the most popular forensic technique—is one of the techniques that can be highly problematic. Even if it is true that no two people have exactly the same fingerprints, this would not mean that fingerprint analysis is accurate and without error. And yet many fingerprint examiners have, for decades, simply asserted without any evidence that identification by fingerprints is perfect and without error—*any error*. This, of course, is absurd. All types of measurement, including all forensic measures, will have some error.

Evidence found at crime scenes is very rarely clear and precise. Objective as they may seem, forensic techniques require that at some point a human try to match one, usually visual, pattern to another. It is here that the powerful effects of expectations on perception come into play. Even DNA results can be misinterpreted by biased technicians. Forensic technicians almost always work for law enforcement agencies and can be easily pressured, consciously or not, to conform their findings to the expectations of the police or prosecutor. Garrett argues that it is extremely important for technicians who analyze forensic evidence to be blind from the expectations of the police. Ideally, forensic laboratories should be totally independent of law enforcement agencies.

The lack of training and qualifica-

tions of forensic technicians and little or no quality control over their work product is another serious problem the book addresses. One of the requirements set out in *Daubert* was that standards for expertise must exist. Such standards are very rare in forensic analysis. Much of what passes for training consists of the handing down of "old cop tales" from one generation of analysts to the next. Real attempts to audit forensic analysists to ensure they are producing accurate results are vanishingly rare—and when they are done, the failure rate has turned out to be unacceptably high.

Garrett discusses two types of problems with what he terms *big data forensics*. The best-known topic here is face recognition programs. These have been shown to be not just inaccurate but racially and ethnically biased. As I write this, Microsoft has acknowledged problems with such software and will remove it "from its artificial intelligence service for detecting, analyzing and recognizing faces" (*The New York Times*, June 22, 2022, p. B1). Hundreds of millions of faces, almost certainly yours and mine, have already been included in huge government-run databases. There are other databases such as CODIS for DNA and IAFIS for fingerprints. These latter databases can be valuable tools for identifying guilty individuals when there appears to be a match. However, Garrett points out—and I had no idea that this was the case—that a defendant's defense team is almost never given access to such databases to check whether the match claimed by the prosecution is accurate.

Also new to me was the "black-box problem." The huge databases are searched by computerized algorithms that are used to detect matches between the crime scene data and data existing in the database. These algorithms were developed by private corporations. There are multiple algorithms from different companies used to search for matches. Because these algorithms are proprietary, companies often refuse to tell anyone, including law enforcement or defense teams, how they work. Thus, there is no way of knowing how accurate they are—or if they're accurate at all. The use of matches derived in such a manner must be a clear violation of the *Daubert* standards.

Another type of black-box problem applies to the reports of the forensic technicians who carry out evaluations of fingerprints, DNA, and the like. The defense is typically given only the bare results of the tests. They are not allowed access to the lab technicians' notes that may reveal serious procedural errors.

The book concludes with a ray of hope in the section on fixing forensics. Some crime labs (Houston, Texas, is a model) are beginning to tighten up controls, evaluations, and procedures. A major problem remains with judges who often refuse to enforce the *Daubert* standards. Because of this, innocent people continue to be sent to prison, and the real criminals continue to be free to commit further crimes. Although Garrett never uses the terms *pseudoscience* or *junk science*, most of the currently popular forensic techniques fall directly into these categories. His book is an excellent review of the problems with such techniques that will surprise and discomfort any reader concerned with improving the criminal justice system. ■

Terence Hines is professor of psychology at Pace University and author of *Pseudocience and the Paranormal*.

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Patterns of Fear and Factual Distortion in America

Peter Huston

America the Fearful: Media and the Marketing of National Panics. By Benjamin Radford. Jefferson, NC: McFarland & Company, Inc., Publishers. ISBN 978-1-4766-8772-8. 226 pp. Paperback, $29.95.

Do the news media sometimes provide a distorted picture of the world around us? Undoubtedly, and social media even more so. And of course the two interact. Social media comments upon or shares the news, and social media's comments, memes, and concerns become news themselves. The interaction between the two increases and accelerates distortion.

Often these distortions become embedded in a person's view of the world, becoming reflexive, automatic, and unthinking. Thus, they are shared again in passing even when journalists or social media users are reporting on mundane, noncontroversial events. Naturally, it's often these distortions that are the most difficult to spot—particularly when they are distorted in a way that seems to confirm and fit our own preconceived biases and views of the world. And many of these are rooted in fear.

In *America the Fearful*, Benjamin Radford not only looks at distortions but seeks the patterns and processes that cause them. Along the way, he notes that many involve exaggerated fears about society, racism, crime, and racial- and gender-based disparities and mistreatment. In fact, fear itself—and the way it clouds rational thinking and fuels emotion-based action—is a common factor in many distortions, which in turn spread and create more fear, hence the title of this book.

Sadly, the list of topics in this far-reaching book is long—very long.

For example, chapter 2, titled "Half Empty," has subsections that include "American Moral Masochism," "Psychology of Selectivity," "Murky Metrics," "Proportionality," "Lenses," "Misleading America," "The QAnon Conspiracy Fizzles," "Quantifying Problems," "Danger Lurking Next Door," "Zooming Out to Gain Perspective," and of course a "Conclusion." That's a lot of ground. And that's a lot of topics. At forty-one pages, it's a long chapter, and the book has six chapters—most of them just as packed with topics. Sources of data used in counterarguments are footnoted. No doubt about it: if you read this book, you will learn something, probably many somethings.

Examples of topics discussed, dissected, and debunked include but are not limited to the alleged and widely reported (yet disproven) racist outcry over a Black Santa at the Mall of America in Minnesota, the alleged and widely believed gap in salaries between male and female film stars today, the alleged disparity in treatment between male and female soccer players in the United States, and many other social concerns that were either exaggerated or never happened.

While Radford is quick to assert his credentials as a liberal progressive, he states that often it is progressives who are quick to believe these sorts of claims, because they reinforce their preconceived image of how they see the world, society, and the beliefs of "Them"— the nameless masses of people who "we" do not know yet who believe and advocate the positions and ideas that we do not like or approve of (and that are widely reported in media as a national menace). After all, if the world reportedly works a certain way, yet no one we know thinks things should be that way, it must be assumed that "They"—a group of terrible anonymous but powerful people—must be doing it, even when, as Radford asserts, in many cases the alleged problems are not occurring at all (or not as often as widely assumed).

There's a lot of ground here. Some of the discussions and explanations are quite interesting. For instance, there was an outcry over a shirt sold on Amazon.com that displayed the slogan "Stay Calm and Rape a Lot." Clearly, this would be offensive and deserving of outrage. However, Radford reveals that the shirt apparently never existed, and it's not proven that any were ever sold. Reportedly, a company developed software to create shirts (and other products) featuring slogans using random verbs upon demand. Then the software would advertise such shirts for sale on Amazon. All of this would take place without human oversight—or misogynistic intent. This is a fascinating use (misuse?) of technology as well as an object lesson in why such software should not be used without human oversight.

There are many reasons fear-induc-

ing, widely reported—yet factually incorrect and distorted news and social media stories—appear. One reason is that activists, no matter the cause they are championing, often exaggerate problems to publicize and seek change for their agendas—whether consciously or unconsciously. This misrepresentation in turn creates misconceptions about the scope of problems. This in turn leads to media content creators writing stories grounded in such portrayals instead of reality. Politicians—sometimes pandering to the masses, sometimes leading them to stoke fear—do the same. Politically slanted media follow their lead. In turn, followers of these media outlets develop slanted, distorted views, demanding action from their politicians. This of course is news in itself, and the media report on it. And so it goes, and so it grows.

Radford spends considerable time on the often (but not always) unconscious use of flawed polls to establish that a problem allegedly exists. These flawed polls are used by both writers reporting on them and activists advocating for social or political change. Of course, very little of this is new; what *is* new is the rate at which the fear and misinformation spreads and the way in which it establishes itself and festers among often isolated internet communities.

Obviously not all readers will agree with all the arguments in this book. For instance, I personally took exception to Radford's argument that men were not terrified of false accusations of sexual misconduct. I mean, I am. (Then again, I've worked in the field of false accusations.) Radford would no doubt point at his sources and state that just because *I'm* terrified does not mean *most* men are. But, hey, scientific or not, I still am terrified. 'Nuff said. My point is *America the Fearful* is a big book, and few will agree with everything in it—even if it is well argued and sourced.

America the Fearful: Media and the Marketing of National Panics covers a lot of important ground. And it's especially important in this day of widespread nontraditional reporting, which spreads both news stories and fears and concerns. Honestly, I went into this book a bit apprehensive. As a former newspaper reporter, I am always wary when people blame that large, faceless, monolithic, mostly mythical entity "the media" for driving some sort of alleged agenda (be it corporate, right wing, left wing, or other depending on who's making the accusation against "the media"). But this is not that kind of book. It's a well nuanced, well thought-out, well argued, and far-reaching critique of some very real social problems caused by the way reports of events are gathered, repackaged, spread, interpreted, and passed along. These events flow and change as people receive them. It seems to me that this book brings a new slant to the old 1960s adage originally voiced by Wes Nisker: "If you don't like the news, go out and make some of your own." ■

America the Fearful: Media and the Marketing of National Panics covers a lot of important ground.

Peter Huston has been a contributor to this magazine since 1992. He is author of several books, including three on skepticism. His website is www.HamchuckWC.com.

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'Best Magazine I've Read in Decades'

I hate junk mail and am cynical of the many pitches I receive, but I read yours and said to myself, "I get this," and I subscribed. Well, it's the best magazine I've read in decades. We all need something to sharpen our sticks and declare our own personal need for truth. I just wonder why I haven't heard of you before. Or was I just throwing away the solicitations?

For the life of me, I cannot understand why companies are allowed to advertise their supplements and unapproved medicines on TV. Millions are being made by companies claiming to fix your memory. I see ads for Prevagen and wonder if it's approved. The internet tells me, "Significant FTC and FDA Legal Issues Related to False Claims" follow them around. Why are they allowed to mislead this way? Then I read the Paul Fidalgo article about the CFI lawsuit [against a homeopathy manufacturer, July/August 2022], and I shouted, "YAY!" Finally, someone is holding their feet to the fire. I've written a couple of letters to Walgreens asking why they sell cigarettes in the front of the store and cancer drugs in the back. They always reply politely but fail to make the change CVS did years ago.

The icing on the cake came in the same July/August 2022 issue with Jeffrey S. Victor's article on the social dynamics of conspiracy rumors. As a writer and political blogger, I sometimes look to place blame for the place where we find ourselves. I have felt the causes were some peoples' educational backgrounds, church teachings, and early childhood physiological damage, but Victor hit the nail on the head. I now understand if one believes in an all-powerful god who watches us and controls everything that happens, they will also believe the lies that spew forth from a self-declared "God-approved" speaker. Victor blends in the element of Satan, who seems to be winning the war. The skeptic in me asks, "If your supreme deity is 'all powerful,' then why do so many terrible things happen?" The assignment of satanic guilt to an individual or group of living people is the most sinister thing a human can do. Without proof Satan or God even exist, how can a mortal man declare someone else is in league with Lucifer?

Sorry for going long here, but I wanted you to know how much I enjoy your magazine. Holding true to the marketing statistics about good experiences with products or services, I have told more than ten of my friends about your publication. Best wishes with keeping the world skeptical and inquiring. I can't wait for the next issue!

Dwight C. Douglas
Writer
Venice, Florida

Quantum Interpretations

I read with some interest Massimo Pigliucci's column in the July/August 2022 Skeptical Inquirer, "What Does It Mean to 'Interpret' Quantum Mechanics?" My connection to quantum mechanics is no longer on the leading edge, let alone the bleeding edge, not having been involved in the field for fifty-five years. However, I have maintained some interest in the subject and have tried to keep a high level of understanding of at least the leading edge.

I have a problem with Pigliucci's statement: "After all, the various interpretations are empirically equivalent, meaning that they all make exactly the same predictions about observable phenomena. Let that sink in: *there is no way to empirically tell apart different interpretations of quantum mechanics*. One might suspect that that this isn't really science. It smells more like … metaphysics."

Because several approaches can give the same interpretations to the same data does not make this metaphysics. This is a philosophic misunderstanding of the methodology of our current scientific method. What is needed to separate between the approaches is that each approach should suggest a method to prove or disprove that approach. For example, both Newtonian and Einsteinian theories of gravity can explain quite adequately the orbit of the Moon around Earth. There was noted a slight error in Newtonian predictions about the orbit of Mercury about the Sun. Einsteinian theory made a correction that matched the data better than Newton. The "proof" of the Einstein theory was in the famous eclipse of the Sun test in 1914.

Each approach to quantum mechanics needs to propose tests of their theories and then let the data show the veracity of the theory. The problems confronting each approach are the increasing complexity of trying to "see" what happens on more and more microscopic levels and that quantum mechanics already involves the "fuzzy" reality due to Heisenberg uncertainty.

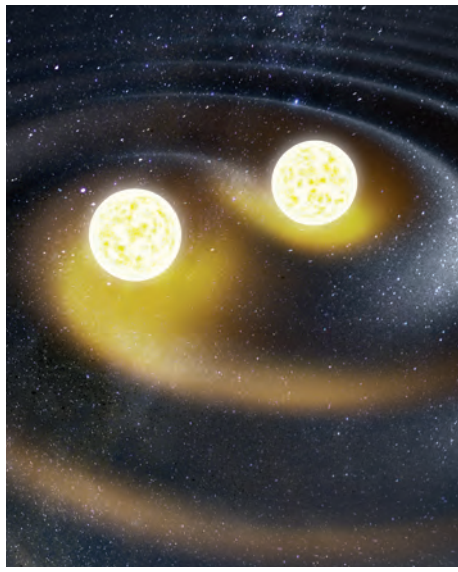
Also, there is an inherent reason that the surveyed physicists stated that they felt that simplicity of theory would be the correct theory. It is because Occam's razor has been correct more often than not in the past. However, as scientists, they should, and most of them probably would, accept a more complicated theory if that theory fit the data better. As mentioned above, Einstein's gravitational theory was not as simple as Newton's but fit the data better. Similarly, Michelson and Morley's experiment threw out Galileo's simple concept of addition of velocities.

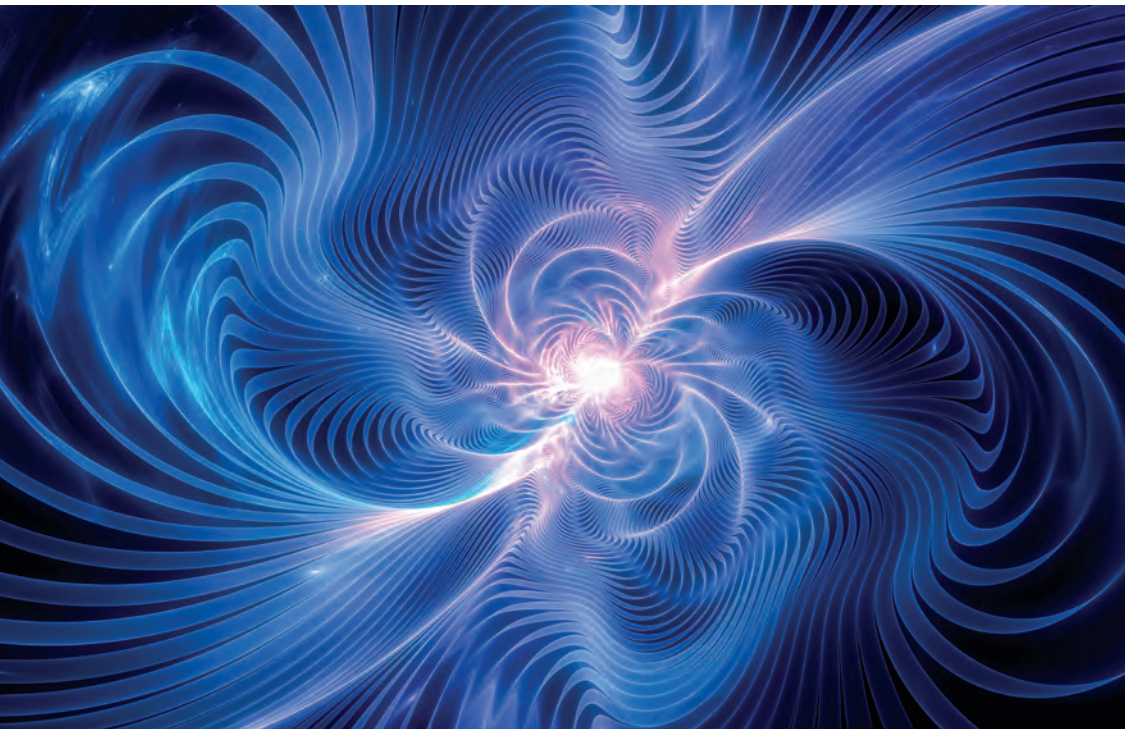
As one of my physics professors stated, "The non-acceptors of those experimental results and the new theories all died." They did not leave students who were nonbelievers (acceptors).

Wilfred C. Lyon
Katy, Texas

I enjoyed reading Massimo Pigliucci's article on the meaning of quantum mechanics. It supported my suspicions that physicists themselves have major problems understanding some of their hypotheses. Being a biologist, I certainly do not understand quantum mechanics, nor do most scientists. I do hold that science is best defined as the study of the physical universe though empirical means. Math is extremely useful in most of science, but math in and of itself is not a science, so any scientific hypothesis based solely on math is simply not empirically supported science. It might be "correct," but without empirical evidence, how will we ever know?

One of my favorite quotes on this matter is from Ernst Mayr, the famed evolutionary biologist.





He wrote that "mathematics, of course, is as little a science as grammar is a language." As to the nature of science, I suspect that if chemists, biologists, geologists, paleontologists, etc., who make up most of working scientists were asked about the nature of science and what constitutes valid scientific truths, they would be in much greater agreement than are the physicists. That is because they work with elements, compounds, organisms, genes, rock strata, minerals, and fossils, which are objectively real and thus sensed empirically.

David Zeigler
Wimberley, Texas

The Mandela Effect

In tracking a quotation about why men go fishing that is widely, but falsely, attributed to Henry David Thoreau, I found an instance of The Mandela Effect creating false memories, as discussed by Massimo Polidoro (July/August 2022). Numerous fly-fishing writers have "remembered" the quotation, usually attributing it to *Walden*. But the quotation does not appear in any writings by Thoreau. Where it does appear, besides in books and articles, is on T-shirts, coffee mugs, tote bags, fridge magnets, mouse pads, and many other artifacts as well as on countless internet sites.

A good example occurs in a book published in 1995 (Michael Baughman, *A River Seen Right: A Fly Fisherman's North Umpqua*, pp. 68–69), in which the author recalls an encounter onstream "eighteen or twenty years ago" with an elderly gentleman who explained why he had cut the points off his flies. He was inspired to do so, he claimed, by reading Thoreau:

> "I think it was in *Walden* where he wrote that a lot of men fish all their lives without ever realizing that fish isn't really what they're after. Well, a while back, I figured out that he was right, at least in my case. The fish are just a reasonable excuse to be out here. If I worry about them too much, I miss a lot of everything else—of what I'm really here for." The old man smiled happily, "Does that make any sense?"
>
> "Sure," I said. "I remember that passage. I know what you mean."

There is no such passage to remember. For my attempt to find the source of this misquotation, see "Famous Thoreau Quotation Is Pretty Fishy" in *The American Fly Fisher*, Winter 2022, pp. 20–24.

Jan Harold Brunvand
Salt Lake City, Utah

I would like to add one more example of an erroneously remembered phrase: Besides the fact that the story of George Washington chopping down the cherry tree was concocted by Parson Weems, the original quote was "I can't tell a lie" rather than "I cannot tell a lie."

I guess people like the iambic meter of the adapted version.

Thomas Robertson
via email

Shifting the Burden of Proof

I read Benjamin Radford's column "Replication in Skeptical Investigation" (July/August 2022) with interest. I've thought about ways to respond to attempts to shift the burden of proof and came up with a response to statements such as "Prove that God doesn't exist" or "You can't prove god doesn't exist." I reply, "I already have; you prove that *I haven't*." In the context of replication, perhaps a good response to demands that skeptics "build a pyramid" would be, "Of course we will—right after you get the aliens to build a pyramid to prove that *they* can do it."

Thank you for addressing the topic with more seriousness than I'm capable of.

Scott Romanowski
Billerica, Massachusetts

[FEEDBACK

The letters column is a forum on matters raised in previous issues.

Letters should be no longer than 225 words.

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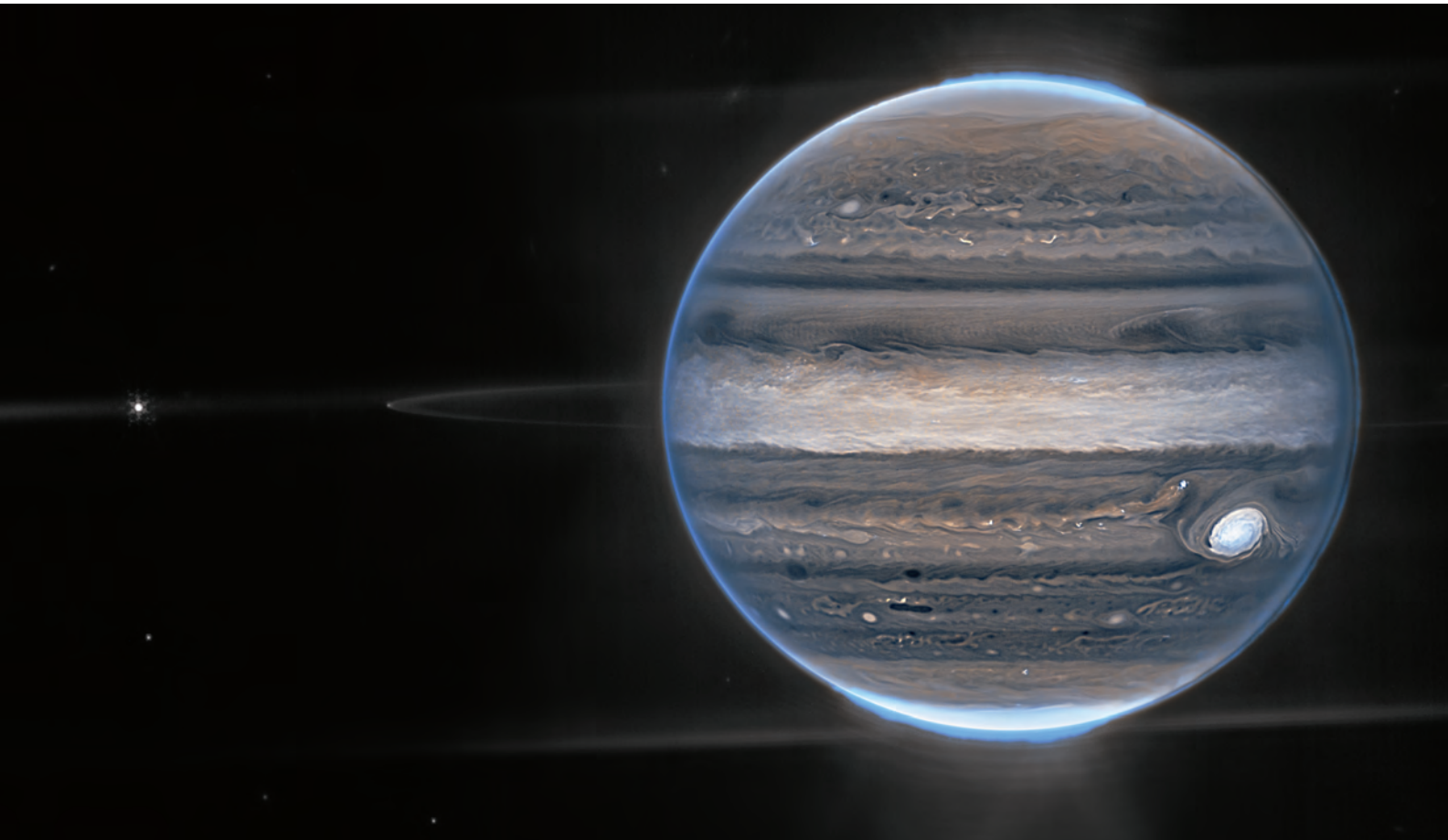

One of the most beautiful photos ever taken of giant planet Jupiter has been captured by the new James Webb Space Telescope. It showcases auroras, hazes, its thin ring system, and one of its moons. Electric blue auroras glow above Jupiter's north and south poles. "We hadn't really expected it to be this good, to be honest," said planetary astronomer Imke de Pater, professor emerita of the University of California, Berkeley. De Pater led the observations of Jupiter with Thierry Fouchet, a professor at the Paris Observatory.

This image comes from the observatory's near-infrared camera, which has three specialized infrared filters that showcase details of the planet. Generally, the longest wavelengths appear redder and the shortest wavelengths are shown as more blue. Scientists collaborated with citizen scientist Judy Schmidt to translate the Webb data into images. In this wide-field view, Webb sees Jupiter with its faint rings, which are a million times fainter than the planet, and two tiny moons called Amalthea and Adrastea. The fuzzy spots in the lower background are likely galaxies "photobombing" this Jovian view.

Credit: NASA, ESA, CSA, Jupiter ERS Team; image processing by Ricardo Hueso (UPV/EHU) and Judy Schmidt.